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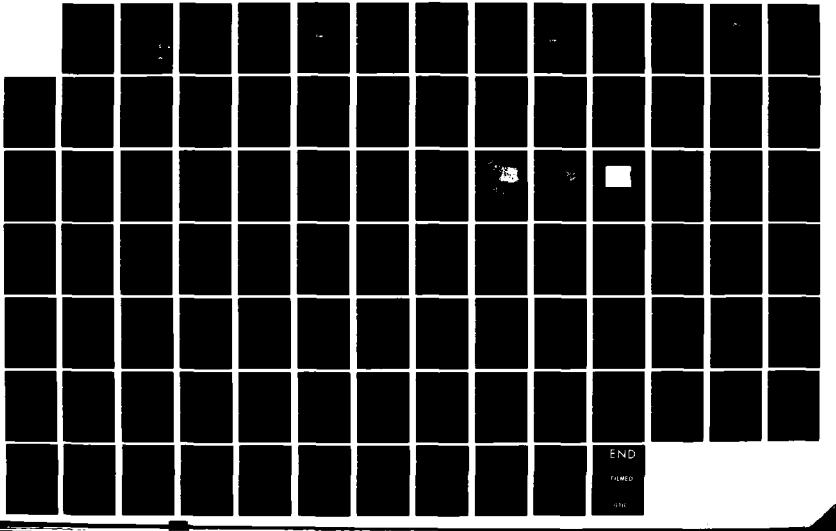

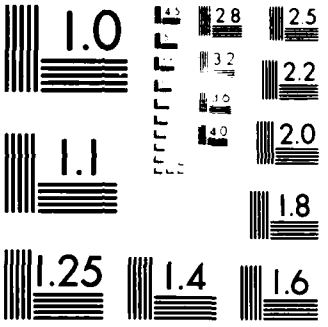

Report USAFSAM-TR-84-24

AD-A149 347

GENETIC EFFECTS OF MICROWAVE EXPOSURE ON MAMMALIAN CELLS IN VITRO: VOLUME II

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October 1984

Annual Report for Period 1 July 1981 - 30 September 1982

Prepared for
USAF SCHOOL OF AEROSPACE MEDICINE
Aerospace Medical Division (AFSC)
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NOTICES

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The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

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Cell growth; cell viability; Chinese Hamster Ovary; chromosome aberrations; DNA repair; human fibroblasts; radiofrequency radiation; RFR; and sister chromatid exchange

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This work is a continuation of studies designed to answer the question of whether radiofrequency radiation (RFR) at lower power levels (no greater than 10 mW/cm^2), where measurable heating in the exposure system cannot be detected, causes any transient or permanent alteration in a series of subtle biochemical processes elicited in the DNA of mammalian cells. The specific process(es) being studied are: the effects of RFR on repair synthesis in normal human fibroblasts after ultraviolet light damage of the DNA; and the possible induction by RFR of sister chromatid exchanges or chromosome aberrations in Chinese Hamster Ovary cells. Additional information obtained in the latter studies includes any effects on cell viability (by cloning efficiency) or on cell growth (increase in cell number).

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CONTENTS

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Figures

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GENETIC EFFECTS OF MICROWAVE EXPOSURE ON MAMMALIAN CELLS IN VITRO: VOLUME II

INTRODUCTION

This work is a continuation of studies designed to answer the question of whether radiofrequency radiation (RFR) at lower power levels (no greater than 10 mW/cm^2), where measurable heating in the exposure system cannot be detected, causes any transient or permanent alteration in a series of subtle biochemical processes elicited in the DNA of mammalian cells. The specific processes being studied are: the effects of RFR on the repair synthesis process in normal human fibroblasts after ultraviolet light (UV) damage of the DNA; and the possible induction by RFR of sister chromatid exchanges (SCE) or chromosome aberrations in Chinese Hamster Ovary (CHO) cells. Additional information obtained in the latter studies includes any effects on cell viability (by cloning efficiency) or on cell growth (increase in cell number).

DNA Repair Studies

In Volume I of this series (for the period February 1, 1980, to June 30, 1981), data were presented for DNA repair studies involving various exposure conditions (5); and, for the convenience of the reader, the respective tables incorporating these data have also been included in this Report (Volume II). Here, the table numbers are as follows:

Table 1. DNA repair study: 1.2-GHz continuous-wave radiation, 37°C;

Table 2. DNA repair study: 1.2-GHz pulse-wave radiation, 37°C;

Table 3. DNA repair study: 350-MHz continuous-wave radiation, 37°C; and

Table 4. DNA repair study: 350-MHz pulse-wave radiation, 37°C.

In conjunction with the continuation of this project, we investigated a possibly more rapid procedure for isolating parental repair replicated DNA (Table 5). We also examined whether RFR at 10 mW/cm^2 had an effect on semi-conservative DNA synthesis (Table 6).

Because a question arose as to whether or not the 1.2-GHz data in Table 2 were really the result of a pulse-wave exposure, the experiment was repeated (Table 9). As described in the "Results" section, other experiments have also been repeated for Volume II of this series, when review of all the available data indicated that some effect of RFR on repair synthesis--albeit transient in nature--might be occurring.

EDITOR'S NOTE: In this Report, BrUdR and BrdU are used interchangeably to represent bromodeoxyuridine. For the convenience of the reader, all tables have been grouped at the close of this publication.

In addition, the experiments were extended to an RFR exposure where the incubation medium was maintained at 39°C, rather than the normal 37°C. This temperature (39°C) was shown not to affect UV-induced repair synthesis by itself (Fig. 4), but was considered to represent a biological system already under "thermal stress" prior to RFR exposure. The data for DNA repair synthesis studies included in this Report are presented in Tables 7-16.

CHO Studies

As just indicated, the genetic studies were expanded to include analysis for any RFR induction of SCEs or chromosome aberrations in CHO cells. These experiments were performed with pulse wave exposures, and at both 37°C and 39°C.

For the cytotoxicity of athermal levels of RFR irradiation to be assessed, a battery of endpoints were studied in cultured hamster fibroblasts (CHO) after exposure to 850 MHz and 1.2-GHz pulsed-wave fields at 10 mW/cm^2. This power density induced no significant increase in the temperature of the culture medium which bathed the cells.

The cellular parameters chosen for these studies were: clonal survival, growth kinetics, morphology, chromosome aberration, and SCE frequencies. All of these endpoints are sensitive indicators of cellular perturbations, with SCE induction probably being the most sensitive (1). The mechanism of SCE induction is unknown; substantial evidence exists, however, that these lesions are related to some disturbance in the cell's normal synthesis of DNA. Therefore, these studies relate well to the examination of RFR effects on UV-induced DNA repair replication.

SCEs were originally observed by Taylor (2), using tritiated thymidine prelabeling and subsequent autoradiography of the chromosomes. An SCE represents a homologous exchange between sister chromatids. These exchanges are most conveniently visualized by using one of the many methods for sister chromatid differentiation (SCE). Most SCE methodologies are based on staining of chromosomes by certain dyes, which are quenched when 5-bromodeoxyuridine (BrdU) has been incorporated into the DNA. Growing cells in BrdU-containing medium for two generations results in the differential BrdU-labeling pattern of chromatids (Fig. 1).

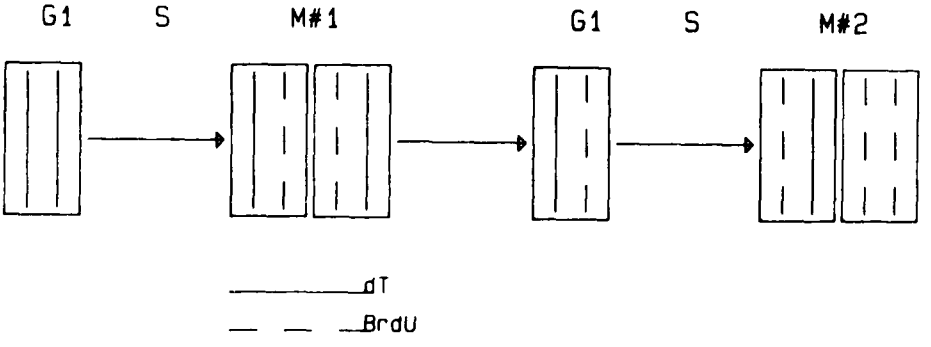


Figure 1. The mechanism of sister chromatid differentiation. (dT = thymidine; and BrdU = bromodeoxyuridine)

The more heavily BrdU-labeled chromatids quench staining more, and therefore, result in a more lightly stained chromatid relative to the sister chromatid. If no SCEs are present, then the chromosome will contain one intensely stained and one lightly stained chromatid--the "harlequin" staining pattern. When SCEs occur, however, they appear as alternating light and dark regions along the long axis of a chromatid, with the sister chromatid having the converse pattern (Fig. 2).

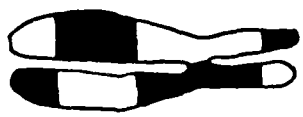


Figure 2. Diagrammatic appearance of chromosomes with three sister chromatid exchanges.

The studies reported herein represent an effort to determine whether or not various cellular processes are affected by exposure of cultured hamster fibroblasts to athermal levels of RFR (850 MHz and 1.2 GHz).

The data for this report are available, in Appendixes A and B, as indicated here:

Raw Data, 850 MHz

The number designations in the following lists refer to page(s) in Appendix A on which data are given.

Experiment No.	SCE	Chromosome No.	Chromosome aberration	Growth kinetics	Surviving fraction
1	A1-A4	A1-A4	A5	A6	A7
2	A8-A11	A8-A11	--	--	A12
3	A13-A16	A13-A16	A17	--	A18
4	A19-A22	A19-A22	A23	A24	A25
5	A26-A29	A26-A29	--	--	A30
6	A31-A34	A31-A34	A35	--	A36

Raw Data, 1.2 GHz

The number designations in the following lists refer to page(s) in Appendix B on which data are given.

Experiment No.	SCE	Chromosome No.	Chromosome aberration	Growth kinetics	Surviving fraction
1	B1-B6	B1-B6	B7	B8	--
2	B9-B14	B9-B14	--	--	B15
3	B16-B21	B16-B21	B22	--	B23
4	B24-B29	B24-B29	--	--	B30
5	B31-B36	B31-B36	B37	B38	--
6	B39-B44	B39-B44	--	--	B45
7	B46-B51	B46-B51	B52	--	B53
8	B54-B59	B54-B59	--	--	B60

METHODS AND MATERIALS

RFR Exposure Facilities and Parameters

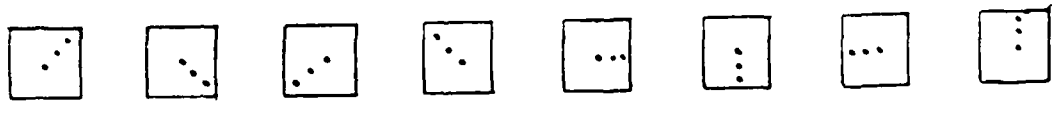
All RFR exposures (see footnote) were conducted, at the USAF School of Aerospace Medicine (USAFSAM), in the anechoic chambers or Narda Model 8801 Transverse Electromagnetic Mode (TEM) Transmission Cell. The exposure geometry for DNA repair experiments,using MRC-5 human diploid fibroblasts, has been described in the "Introduction" in Volume I (5); that for the CHO cells is described in the following section of this report (Volume II).

Specific Absorption Rate Measurements for DNA Repair Studies

Specific absorption rate (SAR) measurements were made for the DNA repair studies with the assistance of the technical staff at USAFSAM. The following procedure was employed:

In preparation for the SAR determination, media was prepared to have the same ingredients and molarities as the exposure media, except that "cold" thymidine (TdR) was used in place of ^{3}H TdR. The media consists of complete Basal Minimal Essential Medium (BME) with Hanks' Salts, 5×10^{-3}M hydroxyurea (HU), 5×10^{-6}M BrUdR, 10^{-6}M 5-fluorodeoxyuridine (FUdR), and 2.7×10^{-7}M TdR. For each SAR we used 80 ml of media in a square dish with a lid with numerous holes.

The SAR determinations were done in anechoic chamber No. 1 at a chamber temperature of 37°C. Four Vitek probes were used--three for media temperatures, and one for room temperature. They were interfaced to a Hewlett Packard 9830A Computer for printout. The 3 media Viteks were moved to various positions in the dish so that the complete field could be determined (viewed from top of dish); e.g.,



NOTE: The exposure parameters for all of our DNA repair experiments, since the beginning of the project, are listed in Table 21.

Temperature measurements were taken at 10-sec intervals during the stabilization period, the 1-min exposure period, and the cool-down period. Three 1-min exposures were done at each Vitek configuration. These temperatures were entered into an SAR computer program with a correction factor to determine the SARs at the actual exposure power level of 10 mW/cm^2.

For 350 MHz, an MCL generator (No.15022) and MCL amplifier (No.10110) were used. Transmitter output power was 1226 W, continuous wave (CW), as compared with the 32 W used for the exposure of 10 mW/cm^2; a correction factor was used to determine the values in Figure 3. The dish was placed in the TEM chamber (Narda 8801) with the circulating fan off.

For 850 MHz, an MCL generator No.15022 with MCL amplifier No.10110 was used. Dosimetry was done at a transmitter output power of 575-W CW, to give a power density of 20 mW/cm^2. Actual SAR exposure output was 600-W CW. A correction factor was used to give the values for a 10 mW/cm^2 exposure (Fig. 4). The square dish with media was placed in a Plexiglas water bath with noncirculating water. Distance from the horn was 1.1 m. Because of the buffer effect of the water bath, more cooling and heating of the media occurred during the stabilization and cool-down periods. The respective data for 350 and 850 MHz are presented in Figures 3 and 4.

Signal Quality Control for DNA Repair Studies

In addition to the stringent control of physical factors (e.g., temperature during exposures), we have begun documenting the quality of the signal being transmitted. This aim is accomplished by analyzing and stroking the signal spectrum with a Hewlett Packard 8566A spectrum analyzer interfaced to a Hewlett Packard 8566B computer with a 9872C eight-pen vector plotter. These data are collected when the transmitter is reconfigured for a new frequency, and during each exposure run to confirm reproducibility.

Figures 5 and 6 show representative spectra for 850 MHz and 1.2 GHz, respectively. Detailed parameters of the signals are presented in the legends.

Exposure Facility for CHO Experiments

Exposures to far-field RFR at 850 MHz and 1.2 GHz were performed in anechoic chamber No.2 (Fig. 7) in Building 1187, Radiofrequency Radiation Research Laboratory, Brooks Air Force Base. The chamber temperature was maintained externally by forced air heating; the deviation in air temperature was approximately ± 0.3°C.

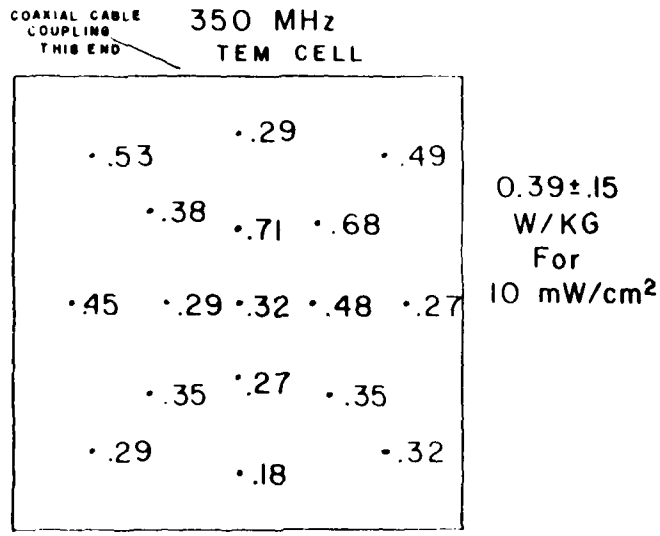


Figure 3. Corrected SAR values at different locations in a square petri dish containing cell culture medium (350 MHz).

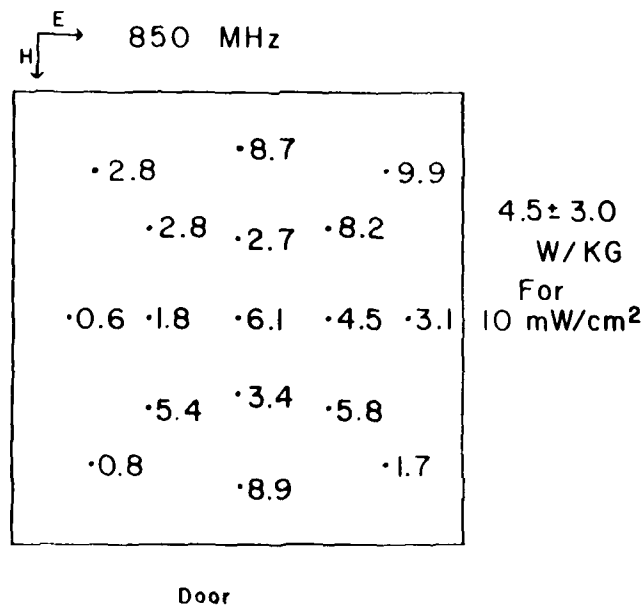


Figure 4. Corrected SAR values at different locations in a square petri dish containing cell culture medium (850 MHz).

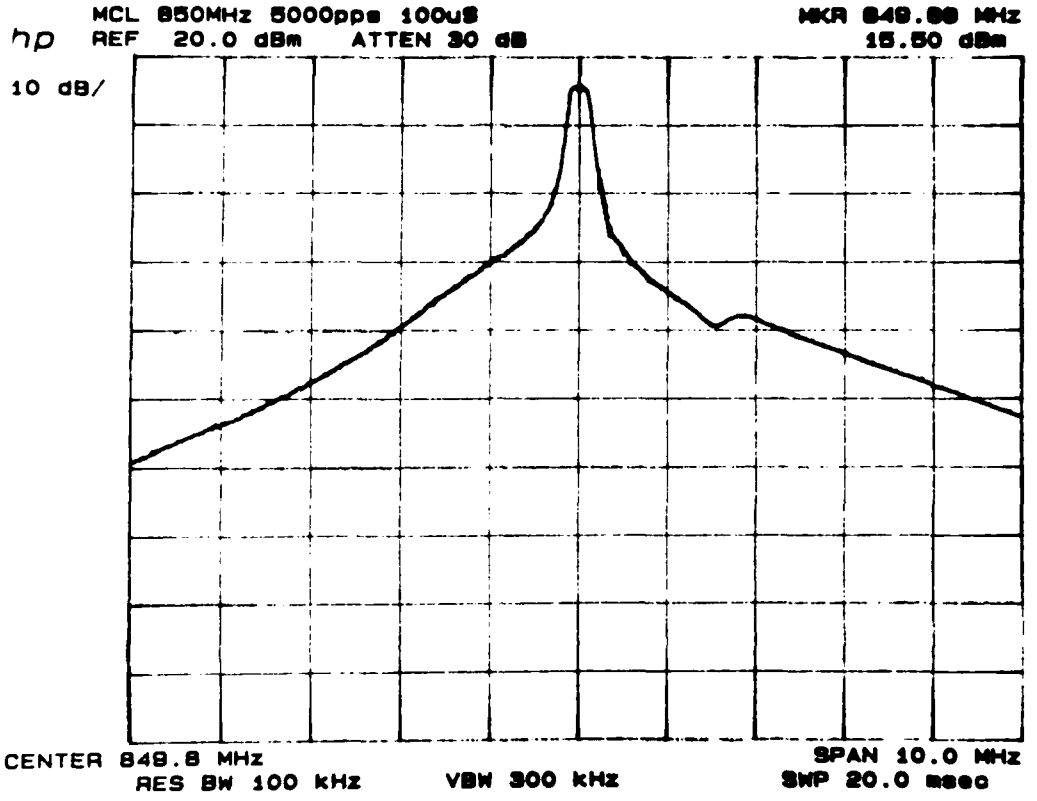


Figure 5. Representative spectra for 850-MHz pulsed wave (5000 pulses/sec, 100-μsec pulse width, MCL transmitter).

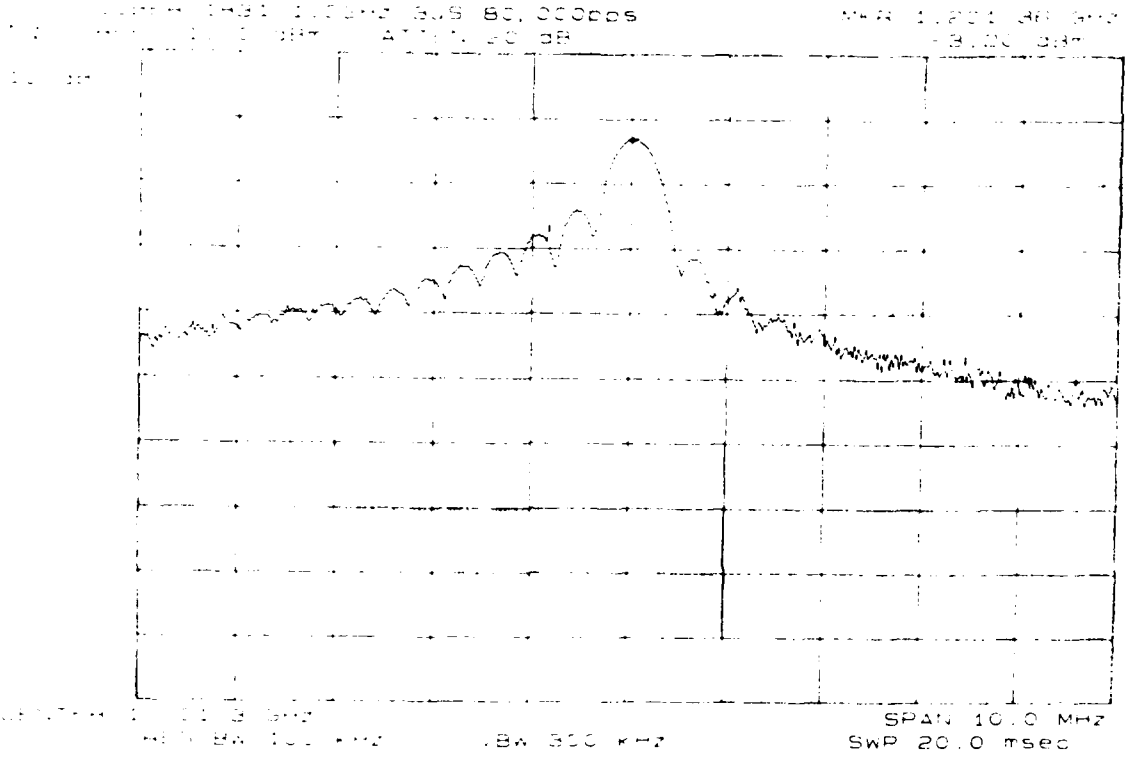


Figure 6. Representative spectra for 1.2-GHz pulsed wave (80,000 pulses/sec, 3-μsec pulse width, Cober Model 1831 transmitter).

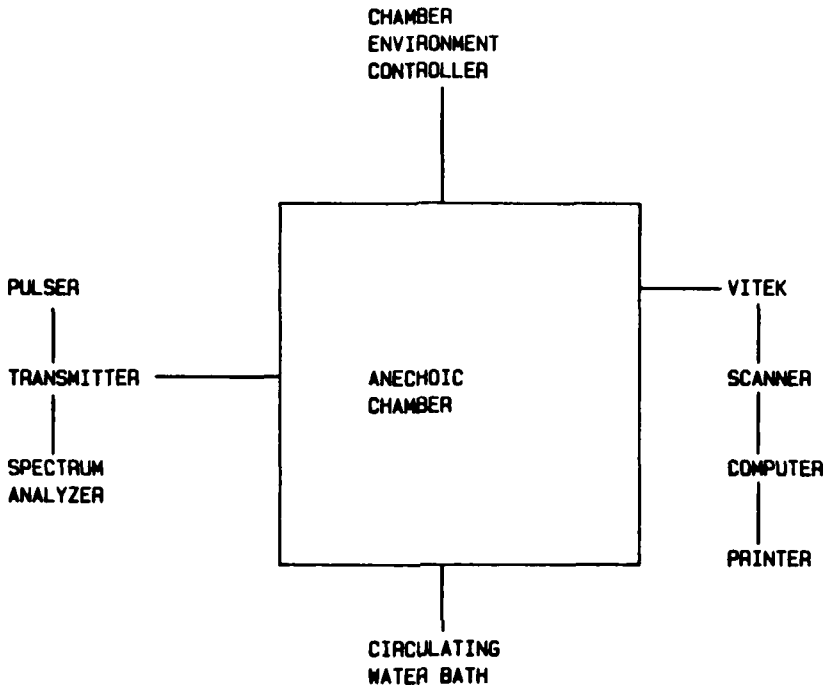


Figure 7. The microwave exposure facility(block diagram).

CHO Cell Exposure Geometry

The CHO cells to be exposed to RFR were contained in T-25 flasks, attached in a 3x3 array to the underside of a sheet of RF-transparent foam. The flask-foam assemblies were floated in water baths connected to a large volume water circulator outside of the anechoic chamber. The experimental water bath was situated in the center of the far field, approximately 1.5 m from the horn. The control water bath was placed out of the field and was shielded by RF opaque material.

Signal Quality Control for CHO Studies

The output frequency of the transmitters was analyzed with a Hewlett Packard spectrum analyzer. Power levels were measured in the far field with Narda probes, a minimum of five points being measured within the area to contain the experimental samples.

SAR Measurements for CHO Studies

The SAR measurement was performed throughout the exposure facility by placing Vitek temperature probes in different positions of each T-25 flask containing 20 ml of growth medium. Maximum transmitter power was imparted on the system, and the temperature rise was measured as a function of time; the power was then removed and the cooling rate was determined. From these data, SARs were estimated by the method of Lozano (3).

Cell Lines

MRC-5 Cells--The MRC-5 normal human diploid fibroblast cell line used in these investigations is an "aging" cell line. It was obtained from the American Type Culture Collection (ATCC), and was kept frozen under liquid nitrogen (in sterile ampoules) until experiments were to be performed. The cells were used only at relatively early passage numbers (before passage 35). Once thawed, the cells were maintained in the biohazard tissue culture laboratories of the Department of Radiology, The University of Texas Health Science Center at San Antonio (UTHSCSA), in BME with Hanks' Salts. HEPES at 25 mM was added to maintain the pH in an air atmosphere. The concentration of fetal calf serum was 10%; antibiotics were added.

CHO Cells--Chinese hamster ovary fibroblasts (originally obtained from Dr. Abraham Hsie, Oak Ridge National Laboratories) were used in all of the described studies. The cells were maintained in exponential growth phase by serial passage by trypsinization, with a split ratio of 1:500 every four days. The medium used was Ham's F12, supplemented with: 10% heat-inactivated (56°C, 30 min) fetal calf serum; 1.8 mM glutamine; 90 units/ml penicillin; and 90 µg/ml streptomycin. Cultures were maintained at 37°C with a humidified atmosphere of 5% carbon dioxide - 95% air.

Cell cultures were routinely monitored for normal morphology and microbial contamination by observation with phase-contrast microscopy. Mycoplasma screening was performed by the fluorescent Hoechst 33258 method.

Procedures for DNA Repair Studies

Fully described in Volume I (5) are the: Cell Culture Procedures for UV and RFR exposures; Repair Replication Protocol; Temperature-Effect Studies; DNA Isolation Procedures; Alkali Cesium Chloride-Cesium Sulfate Density Gradient Procedure; and DNA Concentration Determination--The Hinegardner Technique.

General Experimental Protocol for CHO Studies

Approximately 18 hr preexposure, experimental and control cultures were prepared. An exponential maintenance culture of CHO was harvested by a 15 min treatment with trypsin (0.05% in Earle's balanced salt solution, Ca^{2+} and Mg^{2+} free) at ambient temperature. The culture was passed into the prescribed number of T-25 flasks at a split ratio of 1:32, the total amount of medium being 20 ml. The flasks were placed in an incubator and maintained overnight at 37°C in a humidified atmosphere of 5% CO_2 in air.

Immediately before departure for the transmitter facility, the cultures were tightly wrapped in heavy-duty aluminum foil. This package was transported via automobile; the transport time averaged approximately 30 min. That this method of transfer did not significantly affect any of the cytotoxicity parameters measured was evident when transported cultures were compared with cultures left in the laboratory at UTHSCSA .

Upon arrival at the RFR laboratory, the T-25 flasks were mounted in the holders and placed in the water baths which were pre-equilibrated to either 37° or 39°C. After the cultures had reached experimental temperature, the 3-hr exposure commenced.

After treatment, the cultures were exposed to chemicals when necessary; all were wrapped in heavy-duty aluminum foil and transported to UTHSCSA, where they were returned to a humidified environment of 5% carbon dioxide - 95% air at 37°C.

Clonal Survival

Two hundred cells were plated into three T-25 flasks, 18 hr before RFR exposure. After exposure, the cultures were allowed to proliferate for 4 days. The medium was decanted and the colonies were fixed with methanol:acetic acid (3:1); and colonies were stained with 1% aqueous trypan blue. Colonies were counted with the aid of a dissecting microscope; the lower limit for a clone was 50 cells. Correction was made for multiplicity, and all groups were normalized to their control.

Growth Kinetics

Cells, one flask per time point, were released by trypsinization (as already described) at various times after RFR exposure. Cell numbers per flask were enumerated with an electronic particle counter (Model ZB-I, Coulter Electronics). A total of three counts were made on each sample.

General Morphology

Morphological examination of CHO cultures was performed by phase-contrast microscopy (Olympus Model IMT Inverted Microscope) of living cultures at various times for 72 hr after experimental treatment. Photomicrographs were recorded on Technical Pan 35-mm film (Kodak).

Sister Chromatid Exchange and Chromosome Aberration Analysis

Cells were prepared according to General Experimental Protocol (1:32 dilution of an exponentially grown culture). Immediately after RFR exposure, 100 µl of a solution of 5-bromo-2'-deoxyuridine (2×10^{-4}M in complete culture medium) was added to the existing 20 ml of medium in each flask, thus yielding a final concentration of 10^{-6}M BrdU. From this point forward, the cultured cells were kept wrapped in heavy-duty aluminum foil to prevent

exposure to light; only brief exposures to gold-filtered fluorescent lighting was allowed during required culture manipulations. Cultures were returned to UTHSCSA, and were incubated under standard conditions for 19.5 hr.

To arrest cells in metaphase, 100 µl of colcemid (4×10^{-5}M in complete culture medium) was added to each culture to give a final concentration of 2×10^{-7}M. Standard incubation was allowed to continue for 2.5 hr. The total elapsed time after administration of BrdU was 22 hr, equivalent to two generation times.

Cells were harvested by trypsinization (as described earlier), and were transferred to 15-ml centrifuge tubes. The cells were then pelleted by centrifugation at 80 g for 15 min, and the pellets were resuspended in 10 ml of 0.075M KCl which had been prewarmed to 37°C. Incubation in KCl at 37°C was allowed to proceed for 12 min, and was followed by pelleting at 800 g for 15 min. This pellet was resuspended in 10 ml of methanol:acetic acid (3:1), and allowed to fix for 30 min. The pre-fixed cells were centrifuged at 800 g for 15 min; the pellet was resuspended in 10 ml of fresh methanol:acetic acid (3:1) and refrigerated (4°C) for 24 hr.

The fixed cells were pelleted at 800 g for 15 min, and approximately 9.5 ml of the supernatant was discarded. The pellet was resuspended in the remaining 0.5 ml of fixative. Cells were spread on clean, dry slides by depositing 1 drop of suspension from a height of approximately 12 in. The slides, precleaned in acid-dichromate cleaning solution for a minimum of 24 hr, had undergone exhaustive washing in deionized water and air-drying in a dust-free environment. Slides were air-dried and stored in dust-free storage boxes.

SCE analysis was performed by the fluorescence method of Goto et al. (4). Slides were stained for 5 min in 0.175% acridine orange (C.I. No. 46005) in 0.067 M phosphate buffer (PB), pH 6.8. The slides were then washed in running distilled water for 10 min, and soaked in PB for 10 min; a 22 x 40-mm cover slip was then mounted with a drop of PB.

Slides were observed with a Zeiss Model 18 microscope, equipped with an epifluorescence attachment for blue excitation. When an appropriate metaphase plate was located, the exciter filter was removed in order to allow "burning in" of sister chromatid differentiation. Upon differentiation, the exciter filter was replaced, and the chromosome number and sister chromatid exchanges per cell were scored.

Upon completion of SCE analysis the cover slips were floated off of the slides; these were then stained with a 1:20 dilution of Giemsa stain stock solution in PB for 15 min. The slides were washed in three changes of distilled water, 5 min for each change. After air-drying, 22 x 40 cover slips were mounted with Permount resin.

Chromosome aberration analysis was performed by scoring the frequency of dicentric chromosomes in a total of 500 metaphases.

RESULTS OF THE DNA REPAIR STUDIES

SAR Determinations for DNA Repair Studies

The distribution of values (determined as already described in "Methods") are indicated: in Figure 3, for 350-MHz exposure in the Narda TEM cell; and, in Figure 4, for 850-MHz exposure in the anechoic chamber. The average value for the 350-MHz exposure is 0.39 ± .15 W/kg, with individual values ranging from 0.18 to 0.71 W/kg. For the 850-MHz exposure, the average value is 4.5 ± 3.0 W/kg, with individual values ranging from 0.6 to 9.9 W/kg.

Signal Quality Control for DNA Repair Studies

These determinations are presented in Figures 5 and 6 for 850 MHz pulse-wave (PW) radiation and 1.2-GHz PW radiation, respectively.

Results of Investigation of a Possibly More Rapid Procedure for Isolating Parental Repair Replicated DNA

Investigated in this research was a previously published technique for isolating DNA, by density gradient centrifugation, almost directly from labeled cells (6). If this technique were to prove successful, it could reduce the time necessary to perform a complete assay (currently requiring 1 week for DNA isolation) and two 36-hr density gradient centrifugations.

The results are summarized in Table 5. Included in the experimental data are results obtained when a separate portion of the same UV-irradiated and repair labeled cell population was processed using our standard isolation procedure, and the first of the two alkaline density gradient centrifugation steps was typically performed.

In this attempt, at least, an increasing extent of repair incorporation with increasing UV dose was not detected by the Smith and Hanawalt method, although a dose dependence was evident after only one gradient and pooling in the standard method.

Because the yield (μg DNA/.1 ml) appears to be greater for the Smith and Hanawalt procedure after one gradient, a second alkali gradient added to that procedure might eliminate incorporated radioactivity overlap which we detected in the fractionation profile (continuous O.D. and filter spotting of small aliquots from each fractionation tube). Thereby the UV-induced DNA repair would be allowed to become evident, while still reducing the total assay time. Because a second gradient would be necessary, our decision was not to change techniques at this point in the project.

Results of RFR (10 mW/cm^2) on Semi-Conservative DNA Synthesis

In conjunction with many of the DNA repair studies described herein, a preliminary study was performed to investigate the effect of RFR radiation on semi-conservative DNA synthesis. In either the presence or absence of an RF field at 10 mW/cm^2, MRC-5 cells were allowed to incorporate the DNA precursor ^{3}H-TdR for 1 hr. The DNA was isolated as in the repair studies, and then subjected to one neutral pH density gradient centrifugation. The dpm/µg were determined (Table 6). For all of the PW data--350 MHz (37°C), 350 MHz (39°C), 850 MHz (39°C), and 1.2 GHz (39°C)--the RFR at 10 mW/cm^2 had no effect on precursor incorporation.

For the CW RFR exposure, at 350 MHz (37°C) and 850 MHz (37°C), the 10 mW/cm^2 RFR exposure appeared to result in an increase in incorporation. Because the specific activity of the isolated DNA (dpm/µg) in these two early experiments (Table 6) is so low as compared with that in the more recent PW experiments, drawing a conclusion from the data must be delayed until additional experiments are performed.

Summary of RFR Exposure Effects on UV-Induced DNA Repair Synthesis in MRC-5 Cells

1.2-GHz CW, 37°C--The results for the CW exposure at 37°C for this frequency (Table 7) are plotted graphically in Figure 8, upper panel. No significant effect on incorporated repair radioactivity is evident at either 1 or 10 mW/cm^2 of 1.2-GHz CW exposure.

1.2-GHz PW, 37°C--The original experiment (Table 2) was probably not a PW exposure. The experiment was therefore repeated; the data are presented in Table 9, and are plotted in Figure 8, middle panel (Expt. 1). As can be seen in Figure 8, for both the 1 mW/cm^2 and 10 mW/cm^2 power densities, a "lag" of the repair label incorporation at the 2-hr time point was apparent for the RFR-exposed cells as compared with that for the control cells. The "lag" had disappeared within 3 hr.

To confirm whether or not this observation was reproducible, an additional repeat experiment has been performed at both 1 and 10 mW/cm^2 (Table 12). The results are plotted in the lower panel (Expt. 2) of Figure 8. The original observation is clearly absent; the conclusion is that RFR--at 1.2-GHz PW, 37°C, 1 and 10 mW/cm^2 average power densities--has no effect on DNA repair synthesis.

1.2-GHz PW, 39°C--These experiments have been performed to determine whether incubation of the cells in medium at 39°C during the RFR exposure period, in effect producing a non-RFR induced "thermal stress," resulted in any RFR effect not previously observed at 37°C for 1 and 10 mW/cm^2 average power densities (Table 13). With the generator on, but no RFR being transmitted, incubation of UV-irradiated cells at 39°C in the exposure position does not result in an increase in incorporated repair label above that in the control position (Table 13, Part A). Surprisingly, for 1 mW/cm^2 PW RFR, 39°C (Table 13, Part D), and to a lesser extent for 10 mW/cm^2 PW RFR, 39°C (Table 13, Part E), the incorporated repair radioactivity in the exposed cells was consistently higher than in the control cells. This observation should be confirmed.

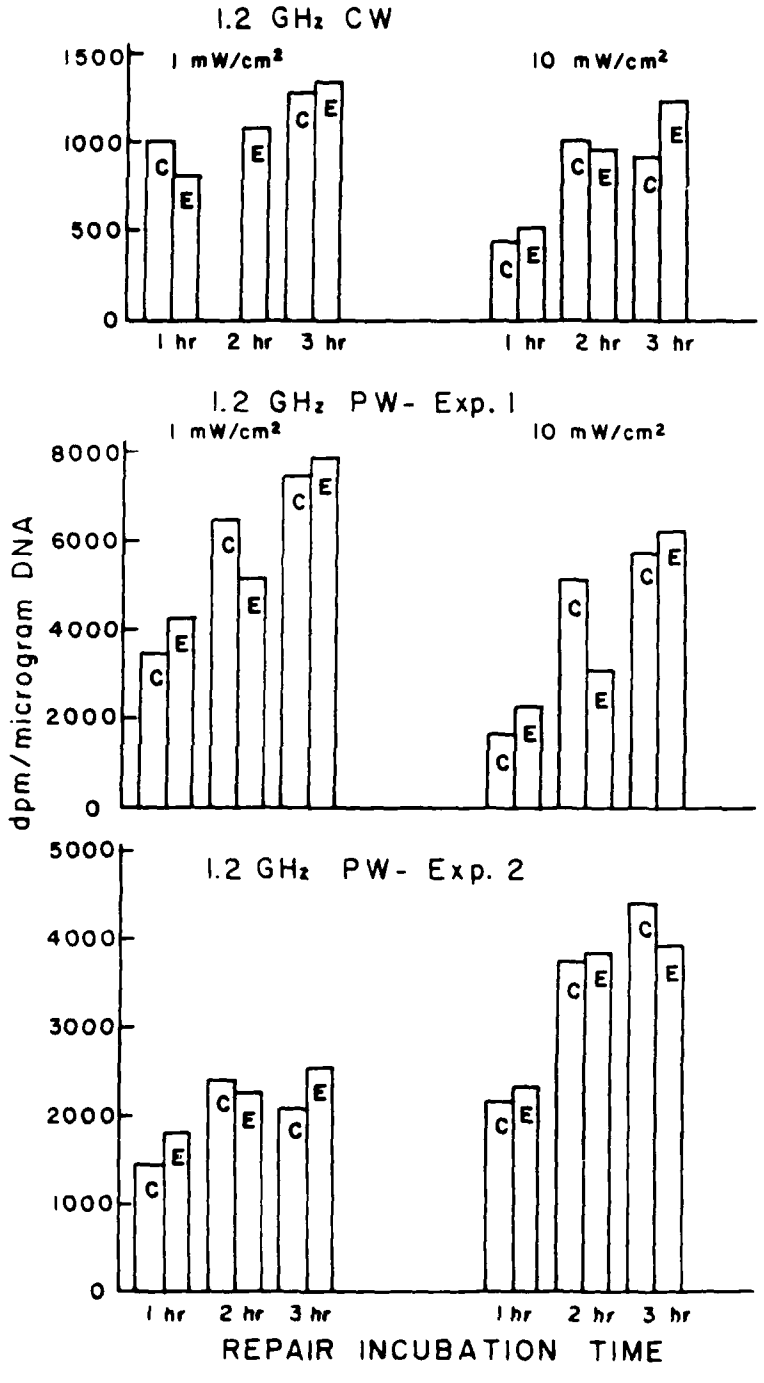


Figure 8. UV-induced DNA repair synthesis during 1.2 GHz RFR exposure at 37°C.

350-MHz CW, 37°C--The results for the CW exposure at 37°C for this frequency (Table 3) are plotted graphically in Figure 9, upper panel. No evidence exists of any effect of 350-MHz CW exposure at either 1 or 10 mW/cm^2.

350-MHz PW, 37°C--The data for 350-MHz PW exposure have been presented in Table 4. At 10 mW/cm^2, no RFR effect was observed (Fig. 9, lower right panel). For the 1 mW/cm^2 exposure, the initial data were unsatisfactory (3-hr values less than 2-hr values), and the experiment was repeated. As can be seen, 1 mW/cm^2 of 350-MHz PW RFR also has no significant effect on DNA repair synthesis (Table 13; and Fig. 9, lower left panel).

350-MHz PW, 39°C--The results of these experiments are shown in Table 15. The exposures in this experiment were 5 and 10 mW/cm^2, instead of the usual 1 and 10 mW/cm^2 average power densities. At both 5 and 10 mW/cm^2, an absence of any effect of 350-MHz PW exposure with incubation at 39°C was noted.

850-MHz CW, 37°C--The original data for this experiment appear in Table 7. Analysis of these data indicated that they were internally inconsistent and not acceptable.

The experiment has therefore been repeated; the data are presented in Table 10, and plotted in Figure 10, upper panel. No indication was noted of any effect of CW exposure at this frequency on DNA repair synthesis.

850-MHz PW, 37°C--The data for this experiment appear in Table 8, and in Figure 10, lower panel. No indication was noted of any effect of PW exposure at this frequency on DNA repair synthesis.

850-MHz PW, 39°C--The results of these experiments are shown in Tables 11 and 16. The data in Table 11, Part D, do not indicate any effect of 1 mW/cm^2 PW RFR at 850 MHz on the DNA repair process at 39°C. At 10 mW/cm^2 in this experiment, however, we noted a continuing inhibitory action on UV-induced DNA repair synthesis, as observed at 2 and 3 hr of incubation.

To confirm this observation, the experiment was repeated. The data are given for both 1 and 10 mW/cm^2 in Table 16. The results do not confirm the previous observation; an 850-MHz PW exposure, at 1 or 10 mW/cm^2 average power density, does not interfere with the DNA repair process in cells incubated at 39°C.

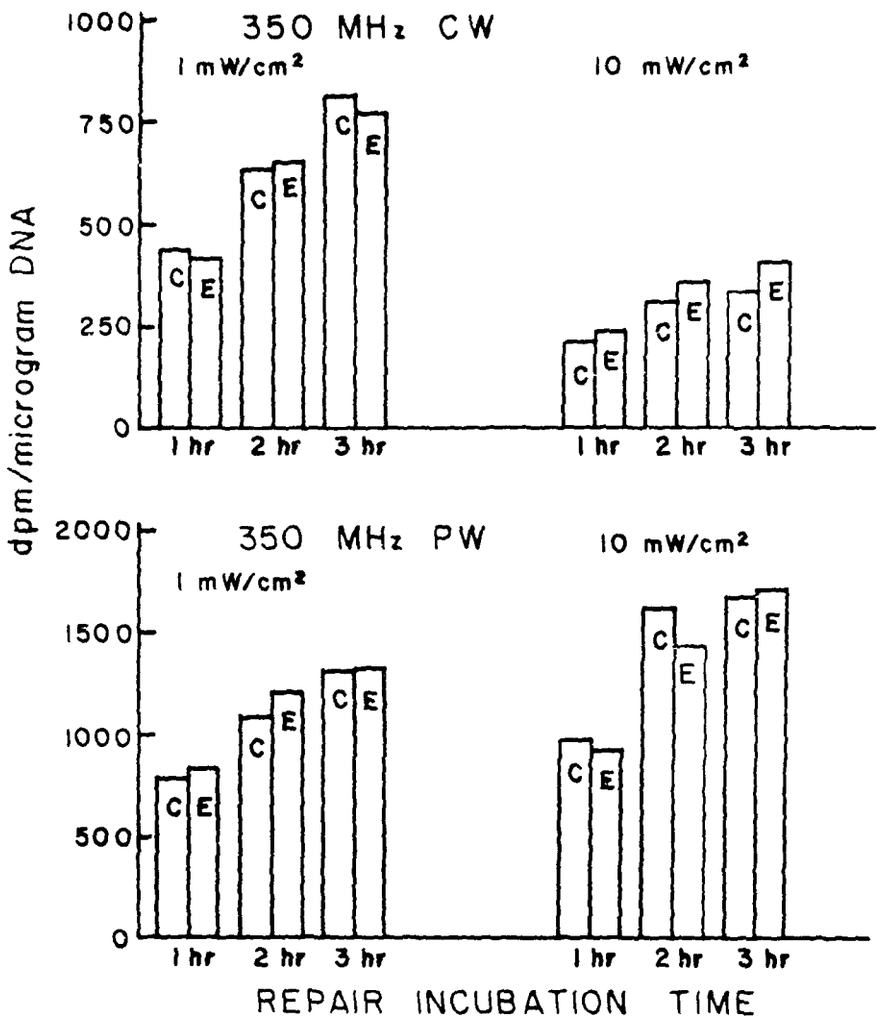


Figure 9. UV-induced DNA repair synthesis during 350-MHz RFR exposure at 37°C.

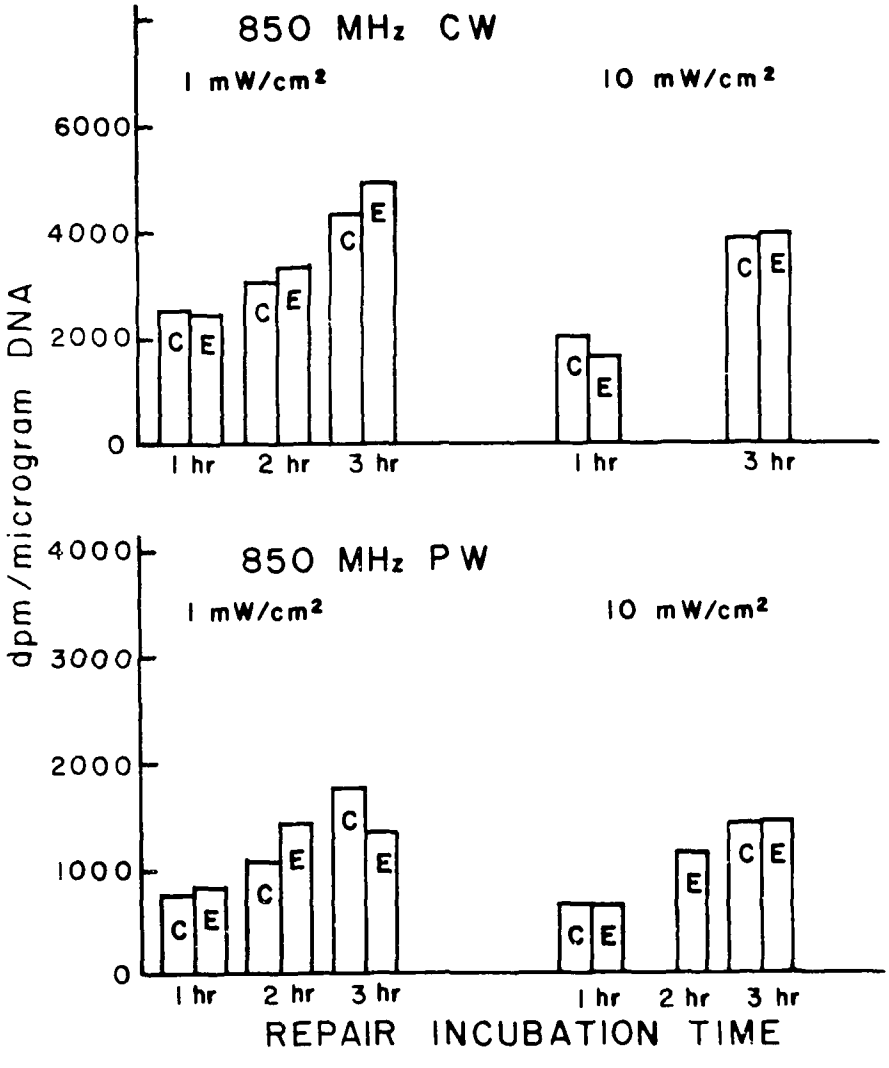


Figure 10. UV-induced DNA repair synthesis during 850-MHz RFR exposure at 37°C.

RESULTS OF THE CHO STUDIES

SAR Measurements for CHO Experiments

The exposure fields have been mapped in terms of power density (mW/cm^2) and are presented in Figures 11 and 12. Specific absorption rate (W/kg) distributions were determined at various locations in the culture medium (Figs.13 and 14). The data in Figure 15 are from a typical SAR experiment; the heating-cooling kinetic data were further treated to yield average SAR values.

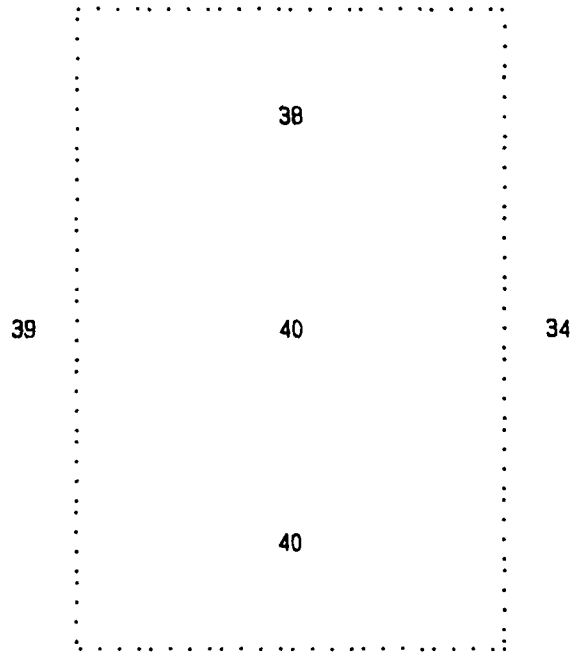


Figure 11. Power-density map, 850 MHz, 350 W. (dotted line = water-bath outline)

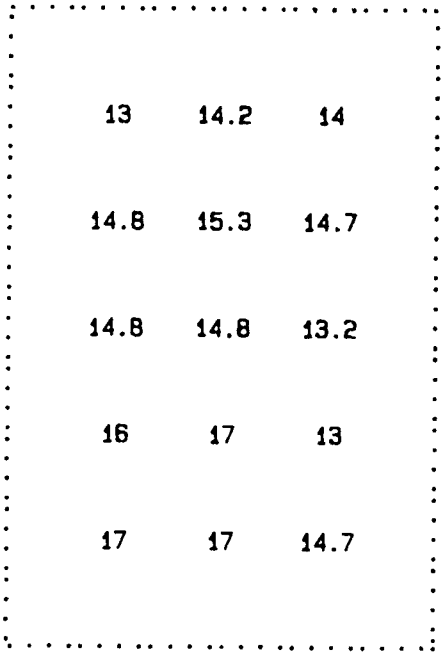


Figure 12. Power-density map, 1.2 GHz, 380 W.
(dotted line = water-bath outline)

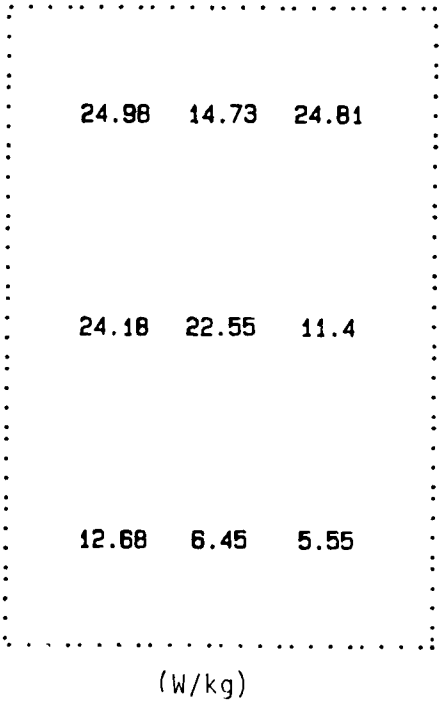


Figure 13. SAR map, 850 MHz, 38 mW/cm^2.
(dotted line = water-bath outline)

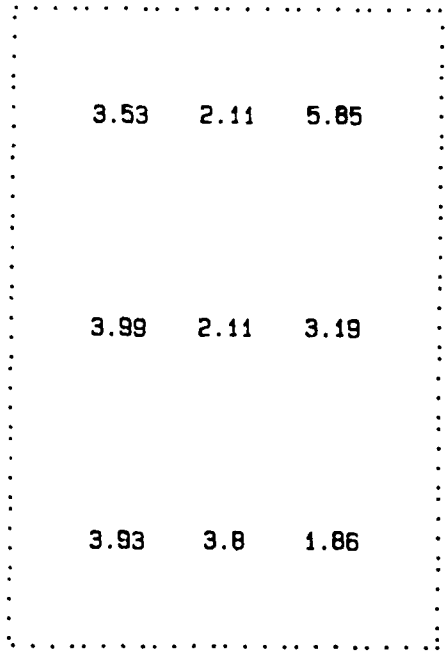


Figure 14. SAR map, 1.2 GHz, 15 mW/cm^2.
(dotted line = water-bath outline)

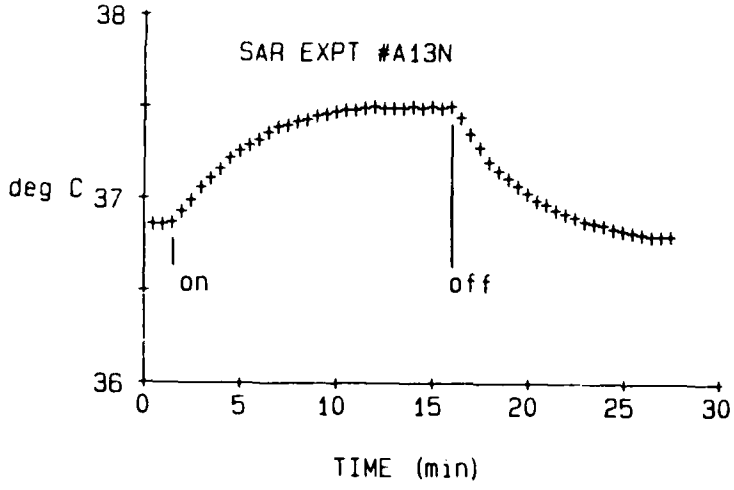


Figure 15. Typical SAR experiment data. (on = magnetron current on; off = magnetron current off)

Power densities were reasonably uniform in the far field for both 350 MHz and 1.2 GHz. The specific absorption rates were fairly similar throughout the 1.2-GHz field; however, some variations in the 350-MHz field were significant.

Signal Quality Control for CHO Studies

A major quality control procedure was spectral analysis of the transmitter output. Figures 16 and 17 are representative spectra for 850 MHz and 1.2 GHz, respectively.

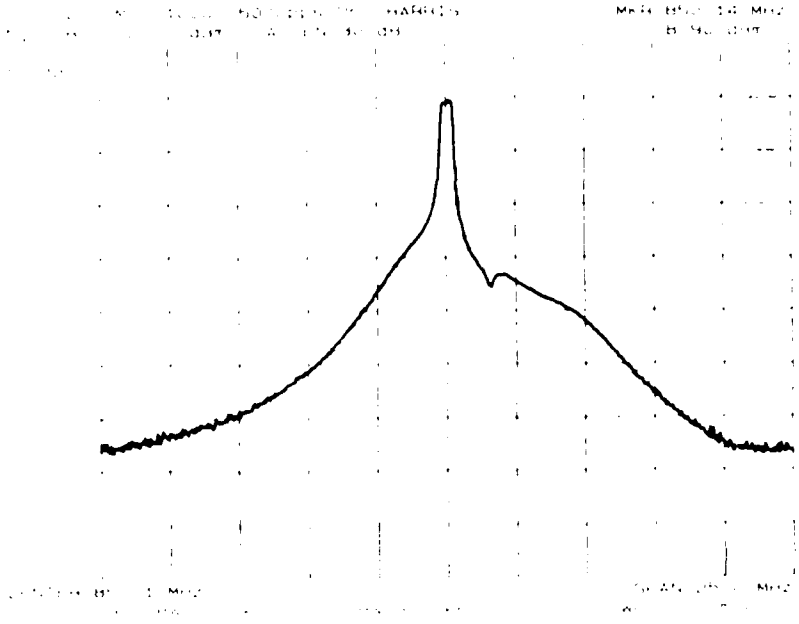


Figure 16. Spectrum analysis of 350-MHz signal.

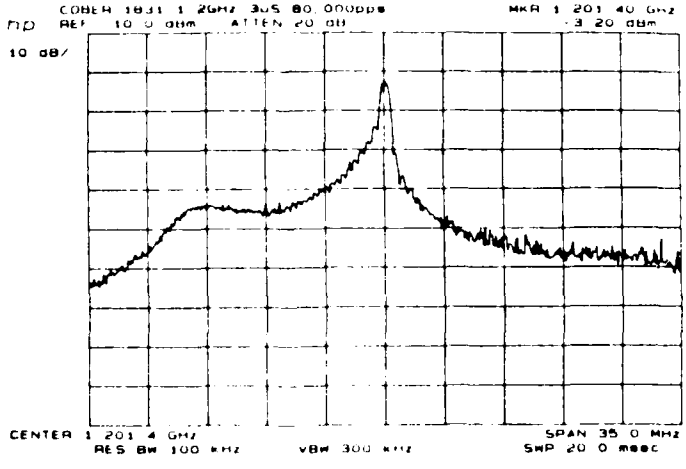


Figure 17. Spectrum analysis of 1.2-GHz signal.

Clonal Survival

No differences in clonal survival were detected between cultures left undisturbed at the UTHSCSA laboratory and those transported to the RFR laboratory. Clonal survival values were the calculated quotient of the number of colonies in each exposed flask and of the mean number of colonies in control flasks. The mean of the clonal survival values is defined as the surviving fraction (SF). These data for 850 MHz and 1.2 GHz are summarized in Table 17. No decline in cell survival was observed under the exposure conditions utilized.

Growth Kinetics

Representative data from four growth kinetics experiments are shown in Figures 18 and 19. The semilogarithmic transforms of the data are linear and fit the equation $C = C_0 e^{\lambda t}$, where: C = number of cells at time t; C_0 = initial cell number; and λ = growth constant. The data for the series of growth kinetics are summarized in Table 13. No differences were detected among the groups; and all had a doubling time of 11 hr, characteristic of CHO cells.

Cellular Morphology

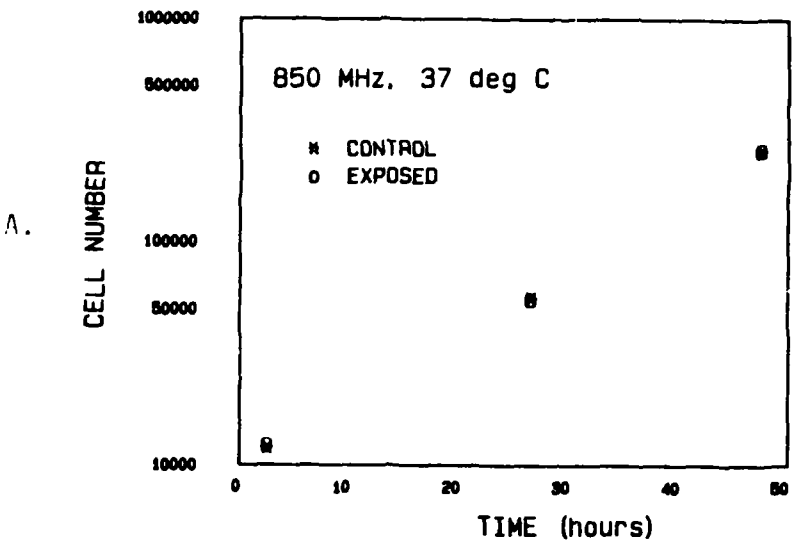
CHO cells grown in monolayer culture exhibit a typical fibroblastic morphology with no outstanding features. The population is homogeneous; however, occasional large multinucleated cells do arise. These unusual cells appear to be reproductively terminal, and therefore do not affect the parameters studied.

Representative phase-contrast photomicrographs of CHO cells at various times after microwave exposure are presented in Figures 20 and 21. None of the experimental treatments caused any demonstrable morphological alterations. Possible morphological changes investigated were: general cell shape and size; membrane blebbing; micronucleation; and granulation and vesiculation of the cytoplasm.

Sister Chromatid Exchange

In each experiment, two or three exposed and control flasks were devoted to SCE analysis. Two slides were analyzed from each flask, fifty metaphases being scored for chromosome number and SCEs per cell. Not included in the scores were metaphases which had obviously had chromosomes lost during preparation, were incompletely spread, or were obviously polyploid. The model chromosome number was 19.

The SCE frequency data for all experiments are contained in Table 19 for 850-MHz PW, and in Table 20 for 1.2-GHz PW; the means (± 1 standard deviation) for each slide are tabulated. Statistical analysis of differences among means was performed by the two-tailed t statistic method. Differences between exposed and control means were not significant ($P<.01$).



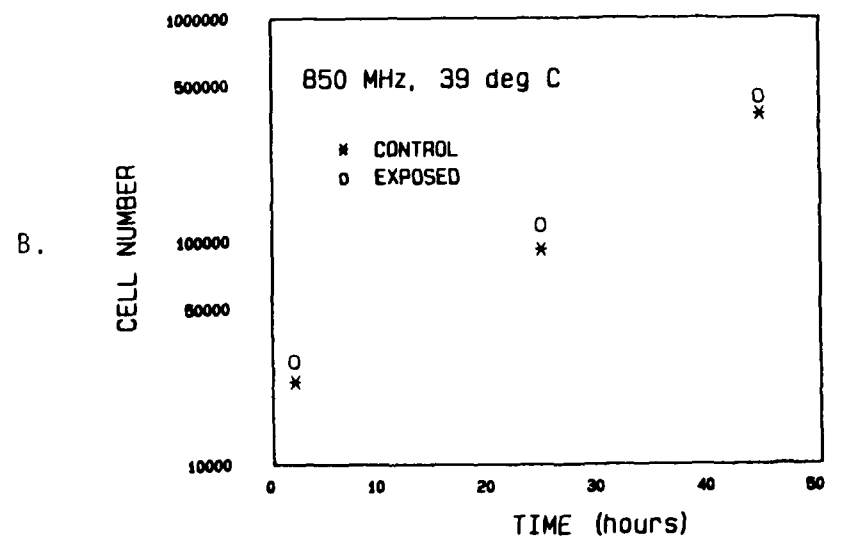
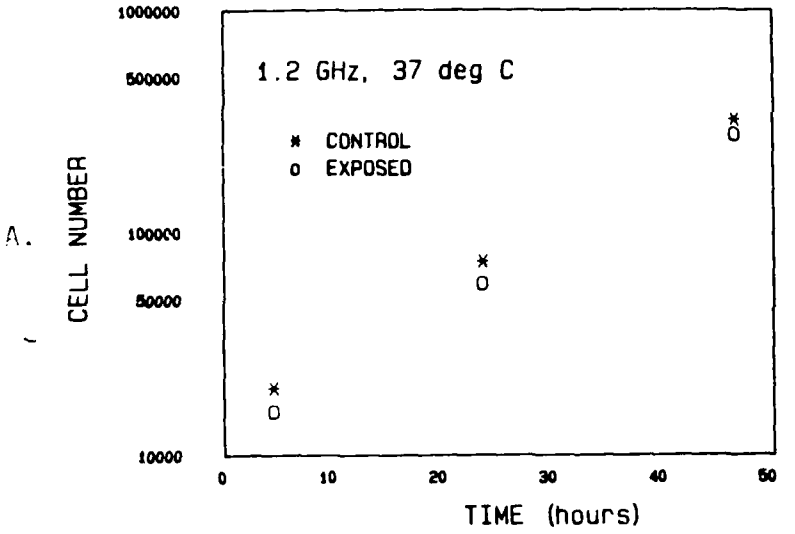


Figure 18. CHO growth kinetics data: A. 850 MHz, 37°C; and B. 850 MHz, 39°C.



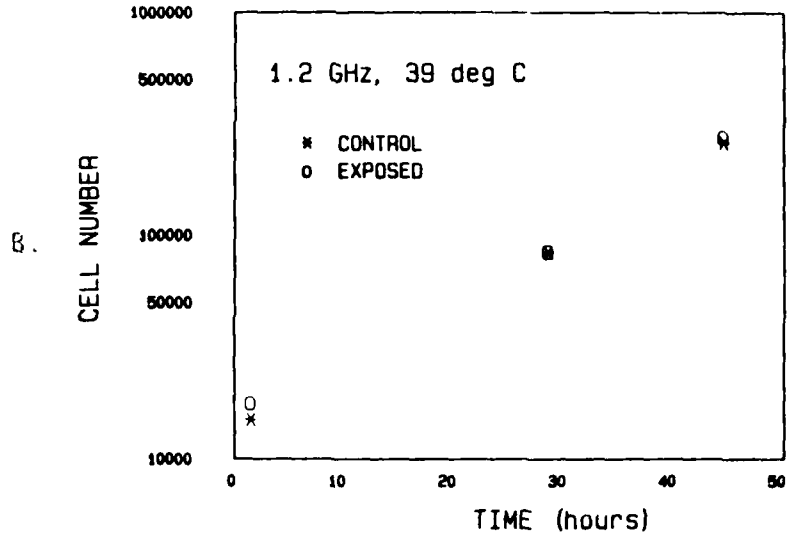


Figure 19. CHO growth kinetics data: A. 1.2 GHz, 37°C; and B. 1.2 GHz, 39°C.

A.

B.

Figure 20. Phase-contrast micrographs of CHO cells, 3 hr after exposure to 850-MHz fields, 37°C: A. Control; and B. Exposed.

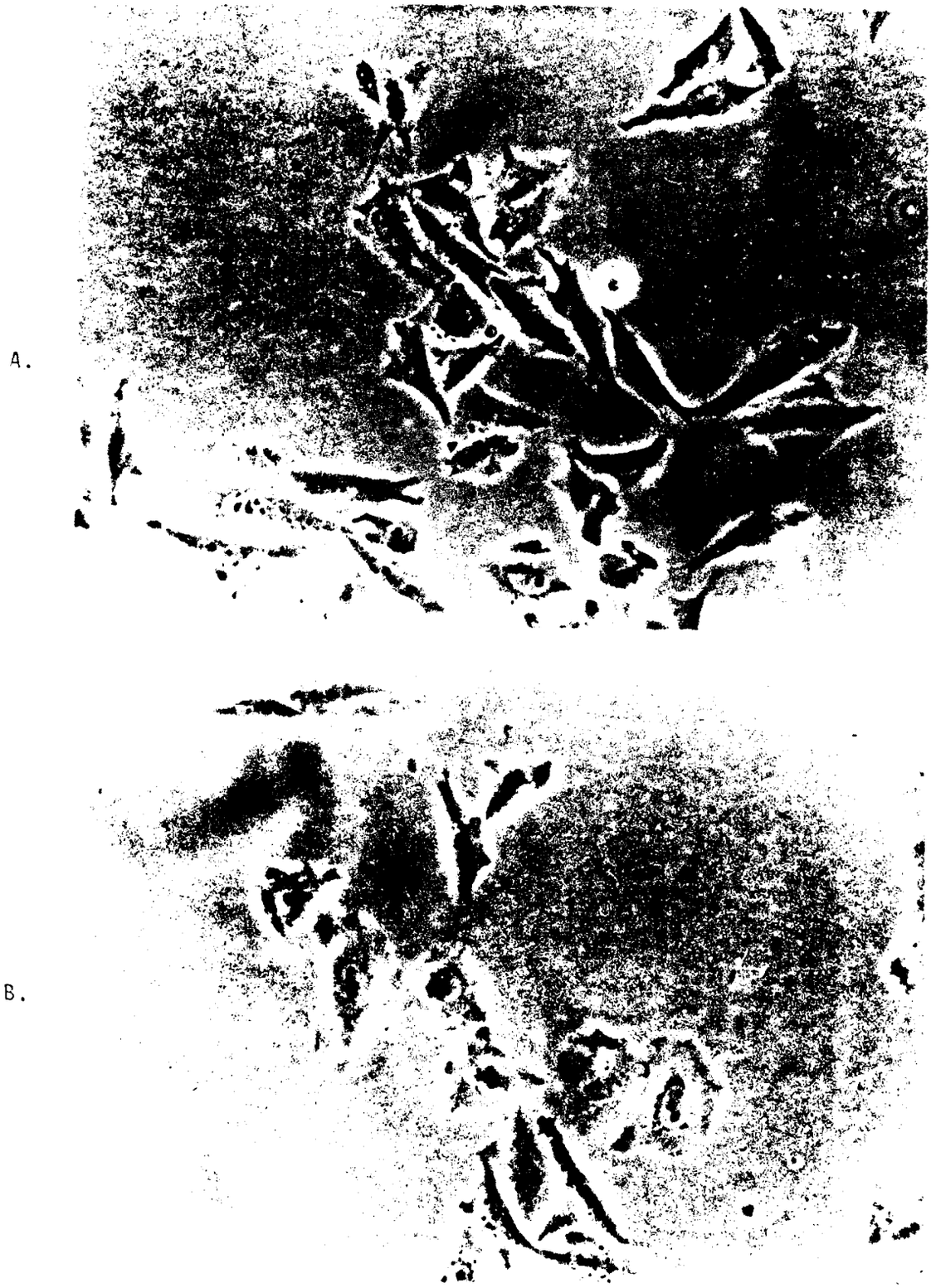


Figure 21. Phase-contrast micrographs of CHO cells, 3 hr after exposure to 1.2-GHz fields, 37°C: A. Control; and B. Exposed.

A typical metaphase for SCE analysis is presented in Figure 22. The photomicrographic quality is poor because of high-intensity red-background fluorescence which tends to create a "haze." However, the observer has a very sharp image for scoring.

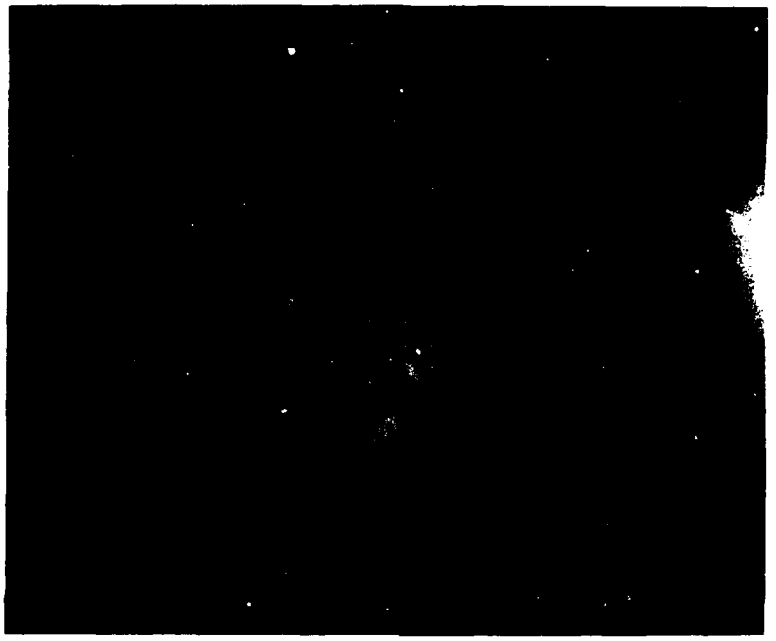


Figure 22. CHO chromosomes for SCE analysis.

Chromosome Aberrations

Under no experimental conditions were any dicentric chromosomes detected. Previous experience discloses that the number of cells scored (500) is sufficient to observe any meaningful increase in the frequency of dicentrics in cultured Chinese hamster fibroblasts.

DISCUSSION

According to the results of these studies, RFR exposure under the described conditions produced no effects on cultured Chinese hamster fibroblasts. The endpoints chosen for these studies encompass a wide variety of potential biological effects. We conclude, therefore, that short-term PW exposure at 850 MHz and 1.2 GHz at an average power density of 10 mW/cm^2 elicits no deleterious cellular effects.

Continuation of these studies at different frequencies and at higher power levels could lead to interesting results. In addition, studies at other frequencies are indicated in order for potential occupational hazards of such exposures to be ascertained.

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TABLES 1 - 21

General note: Throughout the series of tables in the Report, the following abbreviations are frequently used--

"A ratio	= channels ratio, liquid scintillation counter
"bg"	= background
"dpm"	= disintegration(s) per minute
"f.e."	= percent efficiency
"T"	= transverse electric mode

TABLE 1. DNA REPAIR STUDY: 1.0-GHz CONTINUOUS-WAVE RADIATION -- 37°C

[Table 6 of Volume I [a]]

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
A. UV-induced repair replication in anechoic chamber with generator on, in Exposure vs. Control Position. The cells were not exposed to RFR.										
1. Control Position	1	377 280	329	305	.381 .379	.380	36.5	836	1.18	708
2. Exposure Position	1	191 201	196	172	.400 .405	.403	38.0	453	0.64	708
3. Control Position	3	506 496	501	477	.369 .381	.375	36.0	1,325	0.96	1,380
4. Exposure Position	3	284 391	338	314	.399 .374	.387	37.0	849	0.63	1,348
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in anechoic chamber with generator on, in Exposure vs. Control Position. The cells were not exposed to RFR.										
1. Control Position	3	117 143	130	98	.410 .401	.406	40.0	245	0.94	261
2. Exposure Position	3	84 79	82	50	.457 .435	.446	42.5	118	0.56	211

(Continued on next page)

[a] Refer to Item 4 in the paper's list of "References."

TABLE 1 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
C. Assay for induction of repair synthesis by 1.2-GHz continuous-wave radiation in non-UV irradiated cells.										
1. Control	3	151 149	150	118	.413 .405	.409	40.0	295	0.70	421
2. RFR (10 mW/cm^2)	3	176 170	173	141	.400 .378	.389	38.7	364	0.82	444
D. Effect of 1.2-GHz continuous-wave radiation at 1 mW/cm^2 on UV-induced DNA repair.										
1. Control	1	42 42	42	10	.500 .536	.518	45.2	22	0.02[b]	1,100
2. 1 mW/cm^2	1	222 227	225	193	.384 .400	.392	39.0	495	0.61	811
3. Control	2	107 114	111	79	.429 .403	.416	40.5	195	0.92	212[c]
4. 1 mW/cm^2	2	240 207	224	192	.376 .407	.392	39.0	492	0.45	1,093
5. Control	3	297 229	298	266	.390 .379	.385	38.5	691	0.54	1,280
6. 1 mW/cm^2	3	194 177	186	154	.388 .414	.401	39.5	390	0.29[b]	1,345

(Continued on next page)

[illegible]

[illegible]; [illegible] for UV-exposed cells.

TABLE 1 (Cont'd.)

	Incubation time (hr)	cpm .1 mT	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 mT	µg DNA .1 ml	dpm µg DNA
	E. Effect of 1.2-GHz continuous-wave radiation at 10 mW/cm^2 on UV-induced DNA repair.									
1. Control	1	302 195	249	225	.387 .400	.394	37.5	600	1.34	448
2. 10 mW/cm^2	1	141 160	151	127	.407 .425	.416	39.0	326	0.64	509
3. Control	2	291 396	344	320	.396 .374	.385	37.0	865	0.86	1,006
4. 10 mW/cm^2	2	304 289	297	273	.376 .363	.370	35.8	763	0.8	954
5. Control	3	238 205	222	198	.375 .404	.390	37.2	532	0.58	917
6. 10 mW/cm^2	3	70 80	75	51	.471 .437	.454	41.2	124	0.1	1,240

TABLE 2. DNA REPAIR STUDY: 1.2-GHz PULSE-WAVE RADIATION -- 37°C

[Table 2 in Volume I [4]]

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
A. UV-induced repair replication in anechoic chamber with generator on, in Exposure vs. Control Position. The cells were not exposed to RFR.										
1. Control Position	1	94 107	101	77	.376 .424	.400	39	197	0.7	281
2. Exposure Position	1	69 69	69	45	.485 .478	.482	44	102	0.3	340
3. Control Position	3	120 118	119	95	.425 .423	.424	41	232	0.4	580
4. Exposure Position	3	139 138	139	115	.402 .398	.400	39	295	0.51	578
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with generator on, in Exposure vs. Control Position. The cells were not exposed to RFR.										
1. Control Position	3	37 40	39	15	.555 .589	.572	47	32	0.4	80
2. Exposure Position	3	43 40	42	18	.547 .525	.536	45	40	0.45	89

[illegible]

[illegible] See [illegible] "List of Tables."

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
C. Assay for induction of repair synthesis by 1.2 GHz pulse-wave radiation in non-UV irradiated cells.										
1. Control	3	51 53	52	28	.480 .509	.495	43	65	0.95	68
2. RFR (10 mW/cm^2)	3	33 32	33	9	.545 .593	.569	47	19	0.4	48
D. Effect of 1.2 GHz pulse-wave radiation at 1 mW/cm^2 on UV-induced DNA repair.										
1. Control	1	57 57	57	33	.491 .446	.469	43	77	0.2	385
2. 1 mW/cm^2	1	73 73	73	49	.438 .424	.431	41	120	0.28	429
3. Control	2	97 93	95	71	.453 .467	.460	43	165	0.26	635
4. 1 mW/cm^2	2	126 132	129	105	.396 .416	.406	40	263	0.42	626
5. Control	3	64 57	61	37	.492 .456	.474	44	84	0.05	1,680
6. 1 mW/cm^2	3	167 149	158	134	.389 .422	.406	40	335	0.45	744

TABLE 2 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
	E. Effect of 1.2-GHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair.									
1. Control	1	81 81	81	57	.450 .456	.453	40	143	0.5	286
2. 10 mW/cm^2	1	38 43	41	17	.540 .604	.572	47	36	0.15	240
3. Control	2	85 85	85	61	.452 .470	.461	41	149	0.35	426
4. 10 mW/cm^2	2	119 114	117	93	.386 .424	.405	38	245	0.33	742
5. Control	3	105 107	106	82	.419 .452	.436	39	210	0.38	553
6. 10 mW/cm^2	3	146 151	149	125	.413 .400	.407	38	329	0.6	548

TABLE 3. DNA REPAIR STUDY: 350-MHz CONTINUOUS-WAVE RADIATION -- 37°C

[Table 7 in Volume I [a]]

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
A. UV-induced repair replication in TEM Chamber with generator on, vs. in Sham Chamber. The cells were not exposed to RFR.										
1. Sham Chamber	3	385 469	427	402	.309 .321	.315	32	1,256	2.1	598
2. Generator on, TEM Chamber	3	311 306	309	284	.327 .333	.330	33	861	1.35	638
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in TEM Chamber with generator on, vs. in Sham Chamber. The cells were not exposed to RFR.										
1. Sham Chamber	3	57 57	57	33	.491 .491	.491	43	77	1.3	59
2. Generator on, TEM Chamber	3	48 45	47	22	.416 .477	.447	40	55	0.63	87

(Cont'd. on next page)

[a] Refer to Item 6 in the preceding list of "References."

TABLE 3 (Cont'd.)

	Incubation time (hr)	cpm .1 mT	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 mT	µg DNA .1 mT	dpm µg DNA
C. Assay for induction of repair synthesis by 350 MHz continuous-wave radiation in non-UV irradiated cells.										
1. Control	3	42 46	44	19	.476 .422	.449	40	48	0.63	76
2. RFR (10 mW/cm^2)	3	55 51	53	28	.454 .400	.427	39	72	1.0	72
D. Effect of 350-MHz continuous-wave radiation at 1 mW/cm^2 on UV-induced DNA repair.										
1. Control	1	155 146	151	126	.367 .372	.370	36	350	0.8	438
2. 1 mW/cm^2 on	1	116 119	118	93	.387 .372	.380	36	258	0.62	417
3. Control	2	183 167	175	150	.362 .359	.361	35	429	0.68	631
4. 1 mW/cm^2	2	117 118	118	93	.370 .364	.367	35	266	0.41	649
5. Control	3	135 135	135	110	.377 .370	.374	36	306	0.38	805
6. 1 mW/cm^2	3	210 210	210	185	.352 .347	.350	35	529	0.69	767

(Cont'd. on next page)

TABLE 3 (Cont'd.)

	Incubation time (hr)	cpm / .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm / .1 ml	µg DNA / .1 ml	dpm / µg DNA
E. Effect of 350-MHz continuous-wave radiation at 10 mW/cm^2 on UV-induced DNA repair.										
1. Control	1	89 91	90	66	.443 .422	.433	40	165	0.78	212
2. 10 mW/cm^2	1	118 123	121	97	.389 .389	.389	37	262	1.1	238
3. Control	2	128 118	123	99	.433 .358	.396	38	261	0.85	307
4. 10 mW/cm^2	2	119 120	120	96	.403 .420	.412	39	246	0.7	351
5. Control	3	77 80	79	55	.467 .417	.442	40	138	0.42	329
6. 10 mW/cm^2	3	170 165	168	144	.382 .378	.380	37	389	0.95	409

TABLE 4. DNA REPAIR STUDY: 915-MHz FIELD-LAYER VARIATION -- 37°C

[Table 4 in Volume I *]

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
A. UV-induced repair replication in TEM Chamber with generator on, vs. in Sham Chamber. The cells were not exposed to RFR.										
1. Sham Chamber	1	878 862	870	847	.386 .380	.383	37	2,289	1.7	1,347
2. Generator on, TEM Chamber	1	632 653	643	620	.386 .372	.379	37	1,676	1.25	1,341
3. Sham Chamber	3	1,331 1,356	1,344	1,320	.368 .371	.370	36	3,667	1.78	2,060
4. Generator on, TEM Chamber	3	1,278 1,269	1,274	1,250	.374 .379	.377	36	3,472	1.45	2,395
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in TEM Chamber with generator on, vs. in Sham Chamber. The cells were not exposed to RFR.										
1. Sham Chamber	3	356 357	357	334	.433 .435	.434	38	879	1.48	594
2. Generator on, TEM Chamber	3	154 150	152	129	.409 .402	.406	37	349	1.24	281

(Cont'd. on next page)

* Item 5 in the preceding list of "References."

TABLE 3 (cont'd.)

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
C. Assay for induction of repair synthesis by 350-MHz pulse-wave radiation in non-UV irradiated cells.										
1. Control	3	54 56	55	32	.500 .490	.495	42	76	0	---
2. RFR (10 mW/cm^2)	3	239 239	239	216	.424 .447	.436	39	554	0.8	692
D. Effect of 350-MHz pulse-wave radiation at 1 mW/cm^2 on UV-induced DNA repair.										
1. Control	1	121 112	117	94	.475 .446	.461	40	235	0.25	940
2. 1 mW/cm^2	1	535 543	539	516	.433 .421	.427	38	1,358	0.7	1,940
3. Control	2	631 620	626	603	.428 .418	.423	38	1,587	0.75	2,116
4. 1 mW/cm^2	2	712 722	717	694	.428 .421	.425	38	1,826	0.75	2,435
5. Control	3	350 347	349	326	.417 .426	.422	38	858	0.5	1,716
6. 1 mW/cm^2	3	333 523	428	405	.349 .340	.345	33	1,227	0.7	1,753

(Continued on next page)

TABLE 3 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	Avg.	-Bkg	B/A ratio	Avg.	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
E. Effect of 350-MHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair.										
1. Control	1	483 457	470	447	.376 .396	.386	37	1,208	1.24	974
2. 10 mW/cm^2	1	567 570	569	545	.382 .377	.380	37	1,473	1.58	932
3. Control	2	693 754	724	700	.372 .359	.366	36	1,944	1.2	1,620
4. 10 mW/cm^2 [a]	2	535 523	529	506	.376 .372	.374	36	1,406	0.98	1,434
5. Control	3	910 922	916	893	.365 .369	.367	36	2,481	1.48	1,676
6. 10 mW/cm^2	3	910 893	902	878	.369 .367	.368	36	2,439	1.43	1,706

[a] These data are from a continuous-wave exposure, not a pulse-wave exposure.

TABLE 5. SMITH AND HANAWALT (6)[a] TECHNIQUE COMPARISON

Sample	cpm / .1 ml	Avg	-Bkg (30 cpm)	B/A ratio	Avg	%Eff	dpm / .1 ml	µg DNA / .1 ml	dpm / µg DNA
Smith and Hanawalt									
0-sec UV	1,534 1,531	1,533	1,503	.431 .416	.424	34	4,421	1.0	4,421
8-sec UV	1,961 2,187	2,074	2,044	.420 .439	.430	35	5,840	1.6	3,650
15-sec UV	2,333 2,160	2,247	2,217	.432 .425	.429	35	6,334	1.9	3,334
25-sec UV	1,569 1,394	1,482	1,452	.407 .393	.400	33	4,400	1.6	2,750
Old Method - 1 gradient									
0-sec UV	303 279	291	261	.508 .494	.501	39	669	0.38	1,761
8-sec UV	612 612	612	582	.487 .477	.482	38	1,532	0.4	3,829
15-sec UV	557 549	553	523	.491 .478	.485	38	1,376	0.3	4,588
25-sec UV	505 236 [b]	505	475	.432	.432	35	1,443	0.3	4,810

[a] *Refer to item 6 in the preceding list of "References."*

[b] *The replicate cpm was less than half of the indicated value. Its use in the average would have resulted in a 3-hr dpm/µg being less than the 2-hr value and, therefore, was not used in the computation shown.*

TABLE [illegible]. EFFECT OF RFR (10 mW/cm²) ON SEMI-CONSERVATIVE DNA SYNTHESIS

Sample	dpm/.1 ml	Avg	-Bkg	B/A ratio	Avg	%Eff	dpm/.1 ml	µg DNA/.1 ml	dpm/µg DNA
35[illegible]-MHz [illegible] (37°C):									
1-hr control	9,357	9,152	9,129	.335	.336	34	25,[illegible]	4.8	5,593
	8,347			.336					
1-hr 10 mW/cm²	15,971	15,113	15,089	.331	.335	34	44,379	4.7	9,442
	14,255			.338					
350-MHz PW (37°C):									
1-hr control	60,087	59,628	59,605	.359	.361	35	170,300	2.1	81,095
	59,169			.362					
1-hr 10 mW/cm²	53,630	51,289	51,265	.335	.339	34	150,779	1.65	91,381
	48,947			.342					
850-MHz CW (37°C):									
1-hr control	3,624	3,567	3,537	.431	.433	356	9,935	2.8	3,548
	3,509			.435					
1-hr 10 mW/cm²	6,372	5,848	5,818	.357	.353	30	19,393	3.4	5,704
	5,323			.349					

*Cont'd on following page

* Experimental data from different experimental sets [illegible] performed at different times.

(cont'd.)

Sample	cpm .1 ml	Avg	-Bkg	B/A ratio	Avg	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA
850-MHz PW (39°C):									
1-hr control	31,611	30,558	30,536	.415	.415	36	84,883	2.42	35,076
	29,549			.414					
1-hr 10 mW/cm^2	30,705	30,825	30,803	.413	.412	36	85,563	2.26	37,860
	30,944			.410					
850-MHz PW (39°C):									
1-hr control	17,133	16,920	16,897	.471	.471	34	49,697	1.7	29,234
	16,706			.470					
1-hr 10 mW/cm^2	20,150	20,028	20,005	.470	.472	34	58,837	1.9	30,967
	19,905			.474					
1.2-GHz PW (39°C):									
1-hr control	15,726	15,435	15,409	.459	.457	34	45,321	1.1	41,201
	15,144			.455					
1-hr 10 mW/cm^2	17,105	17,411	17,385	.432	.431	32	54,327	1.4	38,805
	17,716			.430					

TABLE 7. DNA REPAIR STUDY: 450-MHz CONTINUOUS-WAVE RADIATION--2.5 mW/cm²

	Incubation time (hr)	cpm .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
A. UV-induced repair replication in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position	1	211 218	181 188	.466 .458	38 37	476 508	2.3	207 221	214
2. Exposure Position	1	390 343	360 313	.438 .438	36 36	1000 869	4.3	233 202	218
3. Control Position	3	457 454	427 424	.459 .454	37 37	1154 1146	2.6	444 441	443
4. Exposure Position	3	496 492	466 462	.449 .444	37 36	1259 1283	3.0	420 428	424
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position	3	60 59	30 29	.474 .525	38 42	79 69	1.5	53 46	50
2. Exposure Position	3	90 94	60 64	.500 .478	40 39	150 164	2.4	63 68	66

TABLE 7 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	C. Assay for the induction of repair synthesis by 850-MHz continuous-wave radiation in non-UV-irradiated cells								
1. Control	3	54	24	.500	40	60	1.4	43	40
		51	21	.529	42	50		36	
2. RFR ($10\ mW/cm^2$)	3	43	13	.558	43	30	0.05	600	3440
		143	113	.440	36	314		6280	
	D. Effect of 850-MHz continuous-wave radiation at $1\ mW/cm^2$ on UV-induced DNA repair								
1. Control	1	214	184	.455	37	497	1.5	331	337
		225	195	.473	38	513		342	
2. $1\ mW/cm^2$	1	202	172	.465	38	453	1.7	266	265
		196	166	.448	37	449		264	
3. Control	2	148	118	.476	38	311	0.7	444	477
		162	132	.459	37	357		510	
4. $1\ mW/cm^2$	2	293	263	.320	28	939	1.2	783	598
		188	158	.382	32	494		412	
5. Control	3	222	192	.457	37	519	0.9	577	600
		232	202	.441	36	561		623	
6. $1\ mW/cm^2$	3	251	221	.384	32	691	1.5	461	630
		389	359	.347	30	1197		798	

(Cont'd. on next page)

TABLE 7 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
E. Effect of 850-MHz continuous-wave radiation at 10 mW/cm^2 on UV-induced DNA repair									
1. Control	1	187	157	.326	28	561	0.9	623	544
		168	138	.389	33	418		464	
2. 10 mW/cm^2	1	140	110	.438	36	306	1.4	219	321
		225	195	.400	33	591		422	
3. Control	2	159	129	.481	39	331	0.8	414	402
		148	118	.469	38	311		389	
4. 10 mW/cm^2	2	130	100	.418	35	286	0.7	409	366
		116	86	.469	38	226		323	
5. Control	3	36	6	.542	43	14	No	---	---
		36	6	.583	45	13	Yield	---	---
6. 10 mW/cm^2	3	175	145	.459	37	392	0.9	436	427
		180	150	.494	40	375		417	

TABLE . DNA REPAIR STUDY: [illegible]-MHz PULSE-WAVE RADIATION--[illegible]

	Incubation time (hr)	cpm .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
A. UV-induced repair replication in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position [a]	1	199	169	.457	37	457	0.7	653	662 [a]
		199	169	.442	36	469		670	
2. Exposure Position [a]	1	251	221	.428	35	631	0.9	701	714 [a]
		265	235	.439	36	653		726	
3. Control Position	3	315	285	.324	28	1018	0.8	1273	1106
		270	240	.382	32	750		938	
4. Exposure Position	3	736	706	.429	35	2017	1.2	1681	1673
		729	699	.429	35	1997		1664	
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position	3	127	97	.492	40	243	0.9	270	285
		130	100	.457	37	270		300	
2. Exposure Position	3	99	69	.438	36	192	0.8	240	223
		96	66	.494	40	165		206	

(Cont'd. on next page)

[a] [illegible] for the last 72 min of the labeling period.

TABLE 1 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
C. Assay for the induction of repair synthesis by 850-MHz pulse-wave radiation in non-UV-irradiated cells									
1. Control	3	38	8	.552	43	19	0.2	95	120
		43	13	.581	45	29		145	
2. RFR (10 mW/cm^2)	3	57	27	.517	41	66	0.3	220	224
		58	28	.517	41	68		227	
D. Effect of 850-MHz pulse-wave radiation at 1 mW/cm^2 on UV-induced DNA repair									
1. Control	1	369	339	.319	28	1211	2.0	606	742
		469	439	.287	25	1756		878	
2. 1 mW/cm^2	1	531	501	.412	34	1474	1.7	867	817
		499	469	.436	36	1303		766	
3. Control	2	267	237	.439	36	658	0.6	1097	1070
		268	238	.460	38	626		1043	
4. 1 mW/cm^2	2	702	672	.413	34	1976	1.4	1411	1418
		728	698	.419	35	1994		1424	
5. Control	3	1061	1031	.424	35	2946	1.5	1964	1784
		872	842	.417	35	2406		1604	
6. 1 mW/cm^2	3	839	809	.366	31	2610	1.9	1374	1337
		795	765	.366	31	2468		1299	

(Cont'd. on next page)

TABLE 1 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
E. Effect of 850-MHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair									
1. Control	1	478	448	.426	35	1280	1.9	674	688
		496	466	.421	35	1331		701	
2. 10 mW/cm^2	1	494	464	.365	31	1497	2.3	651	679
		534	504	.371	31	1626		707	
3. Control	2	166[b]	136[b]	.460	38	358[b]	0.9	159	150
		148[b]	118[b]	.455	37	319[b]		141	
4. 10 mW/cm^2	2	108	78	.500	40	195	0.2	975	1168
		128	98	.445	36	272		1360	
5. Control	3	624	594	.431	35	1697	1.2	1414	1423
		631	601	.424	35	1717		1431	
6. 10 mW/cm^2	3	1259	1229	.433	36	3414	2.4	1423	1451
		1271	1241	.426	35	3546		1478	

[b] These values are for 0.25 ml, not 0.1 ml.

TABLE 9. DNA REPAIR STUDY: 1.-GHz PULSE-WAVE RADIATION--37°C

	Incubation time (hr)	cpm .1 mT	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 mT	µg DNA .1 mT	dpm µg DNA	Avg dpm µg DNA
	A. UV-induced repair replication in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.								
1. Control Position	1	727	697	.433	32	2178	1.15	1894	1756
		662	632	.461	34	1859		1617	
2. Exposure Position	1	sample lost							
3. Control Position	3	152	122	.506	37	330	0.1	3297	3304
		159	129	.534	39	331		3310	
4. Exposure Position	3	1835	1805	.450	33	5470	1.75	3126	3201
		1922	1892	.450	33	5733		3276	
	B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.								
1. Control Position	3	225	195	.482	35	557	1.9	293	287
		222	192	.488	36	533		281	
2. Exposure Position	3	212	182	.481	35	520	1.85	281	278
		208	178	.478	35	509		275	

(Cont'd. on next page)

TABLE 9 (Cont'd.)

	Incubation time (hr)	cpm / .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm / .1 ml	µg DNA / .1 ml	dpm / µg DNA	Avg dpm / µg DNA
C. Assay for the induction of repair synthesis by 1.2-GHz pulse-wave radiation in non-UV irradiated cells									
1. Control	3	534	504	.487	36	1400	1.1	1273	1259
		523	493	.484	36	1369		1245	
2. RFR (10 mW/cm^2)	3	215	185	.353	27	685	0.85	806	867
		243	213	.359	27	789		928	
D. Effect of 1.2-GHz pulse-wave radiation at 1 mW/cm^2 on UV-induced DNA repair									
1. Control	1	443	413	.555	40	1033	0.3	3443	3457
		436	406	.547	39	1041		3470	
2. 1 mW/cm^2	1	838	808	.540	39	2072	0.5	4144	4283
		870	840	.525	38	2211		4422	
3. Control	2	266	236	.554	40	590	0.09	6556	6484
		255	225	.533	39	577		6411	
4. 1 mW/cm^2	2	985	955	.495	36	2653	0.5	5306	5190
		994	964	.519	38	2537		5074	
5. Control	3	1058	1028	.533	39	2636	0.35	7531	7476
		1043	1013	.535	39	2597		7420	
6. 1 mW/cm^2	3	1259	1229	.532	39	3151	0.4	7878	7893
		1232	1202	.529	38	3163		7908	

(Cont'd. on next page)

TABLE 9 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (30 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
E. Effect of 1.2-GHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair									
1. Control	1	213	183	.504	37	495	0.3	1650	1650
		218	188	.518	38	495		1650	
2. 10 mW/cm^2	1	701	671	.470	35	1917	0.85	2255	2281
		716	686	.474	35	1960		2306	
3. Control	2	1347	1317	.537	39	3377	0.65	5195	5189
		1344	1314	.532	39	3369		5183	
4. 10 mW/cm^2	2	821	791	.520	38	2082	0.7	2974	3069
		849	819	.503	37	2214		3163	
5. Control	3	1413	1383	.531	39	3546	0.6	5910	5775
		1316	1286	.529	38	3384		5640	
6. 10 mW/cm^2	3	1699	1669	.533	39	4279	0.7	6113	6216
		1755	1725	.531	39	4423		6319	

TABLE 13. DNA REPAIR STUDY: 9450-MHz CONTINUOUS-WAVE RADIATION--37°C

	Incubation time (hr)	cpm .1 ml	-Bkg (23 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
A. UV induced repair replication in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position	1	313	290	0.500	35	829	0.3	2762	2733
		307	284	0.496	35	811		2703	
2. Exposure Position	1	517	494	0.497	35	1411	0.5	2822	2829
		505	482	0.489	34	1418		2836	
3. Control Position	3	493	470	0.481	33	1424	0.3	4747	4530
		476	453	0.496	35	1294		4313	
4. Exposure Position	3	1268	1245	0.481	33	3773	0.6	6288	6193
		1267	1244	0.486	34	3659		6098	
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position	3	120	97	0.544	37	262	1.3	202	200
		121	98	0.550	38	258		198	
2. Exposure Position	3	123	100	0.560	38	263	1.0	263	272
		127	104	0.547	37	281		281	

(Cont'd. on next page)

	Incubation time (hr)	cpm .1 ml	-Bkg (23 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	C. Assay for the induction of repair synthesis by 850 MHz continuous wave radiation in non-UV-irradiated cells								
1. Control	3	121	98	0.541	37	265	1.0	265	284
		132	109	0.526	36	303		303	
2. RFR (10 mW/cm^2)	3	121	98	0.550	38	258	0.9	287	299
		121	98	0.512	35	280		311	
	D. Effect of 850-MHz continuous-wave radiation at 1 mW/cm^2 on UV-induced DNA repair								
1. Control	1	895	872	0.490	34	2565	1.0	2565	2561
		892	869	0.492	34	2556		2556	
2. 1 mW/cm^2	1	1065	1042	0.497	35	2977	1.2	2481	2440
		1030	1007	0.496	35	2877		2398	
3. Control	2	641	618	0.486	34	1818	0.6	3030	3043
		628	605	0.478	33	1833		3055	
4. 1 mW/cm^2	2	1286	1263	0.486	34	3715	1.1	3377	3335
		1254	1231	0.480	34	3621		3292	
5. Control	3	1497	1474	0.479	34	4335	1.0	4335	4351
		1464	1441	0.470	33	4367		4367	
6. 1 mW/cm^2	3	1693	1670	0.484	34	4912	1.0	4912	4930
		1705	1682	0.486	34	4947		4947	

(Cont'd. on next page)

TABLE 10 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (23 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	E. Effect of 850-MHz continuous-wave radiation at 10 mW/cm^2 on UV-induced DNA repair								
1. Control	1	1319	1296	0.492	34	3812	1.8	2118	2051
		1272	1249	0.496	35	3569		1983	
2. 10 mW/cm^2	1	743	720	0.439	31	2323	1.2[a]	1936(2323)	1602
		540	517	0.480	34	1521	(1.0)[b]	1268(1521)	(1922)
3. Control	Samples lost due to water bath overflow during exposure								
4. 10 mW/cm^2	Samples lost due to water bath overflow during exposure								
5. Control	3	1633	1610	0.493	34	4735	1.2	3946	3884
		1582	1559	0.486	34	4585		3821	
6. 10 mW/cm^2	3	1367	1344	0.491	34	3953	1.0	3953	3964
		1374	1351	0.489	34	3974		3974	

[a] Value from one Hinegardner replicate. The 2nd replicate was "0.1 ml," and gave a much lower reading.

[b] The values in parentheses are the average of both replicates, which was calculated using the same.

[illegible] 1-MHz PULSE-MOD RADIATION--39°C

	Incubation time (hr)	cpm .1 ml	-Bkg (123 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
A. UV induced repair replication in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control	1	1176	1153	.477	34	3391	1.2	2826	2768
Position		1161	1138	.484	35	3251		2709	
2. Exposure	1	1204	1181	.485	35	3374	1.3	2595	2554
Position		1166	1143	.482	35	3266		2512	
3. Control	3	1663	1640	.484	35	4686	1.3	3605	3610
Position		1668	1645	.482	35	4700		3615	
4. Exposure	3	1834	1811	.479	35	5174	1.3	3980	4009
Position		1860	1837	.479	35	5249		4038	
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control	3	73	50	.589	41	122	0.3	407	442
Position		80	57	.575	40	143		477	
2. Exposure	3	176	153	.511	37	414	1.0	414	411
Position		170	147	.497	36	408		408	

TABLE 11 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (23 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
C. Assay for the induction of repair synthesis by 850-MHz pulse-wave radiation (39°C) in non-UV-irradiated cells									
1. Control	3	177	154	.519	37	416	0.5	832	824
		174	151	.522	37	408		816	
2. RFR (10 mW/cm^2)	3	181	158	.502	36	439	0.6	732	714
		173	150	.497	36	417		695	
D. Effect of 850-MHz pulse-wave radiation (39°C) at 1 mW/cm^2 on UV-induced DNA repair									
1. Control	1	1727	1704	.503	36	4733	1.7	2784	2749
		1684	1661	.495	36	4614		2714	
2. 1 mW/cm^2	1	1746	1723	.497	36	4786	1.9	2519	2512
		1736	1717	.498	36	4758		2504	
3. Control	3	2575	2552	.491	35	7291	1.2	6076	5916
		2440	2417	.491	35	6906		5755	
4. 1 mW/cm^2	3	2997	2974	.492	35	8497	1.4	6069	6006
		2936	2912	.489	35	8320		5943	

(Cont'd. on next page)

	Incubation time (hr)	cpm / .1 ml	-Bkg (23 cpm)	B/A ratio	%Eff	dpm / .1 ml	µg DNA / .1 ml	dpm / µg DNA	Avg dpm / µg DNA
E. Effect of 850-MHz pulse-wave radiation (39°C) at 10 mW/cm^2 on UV-induced DNA repair									
1. Control	1	1065	1042	.492	35	2977	0.7	4253	4149
		1014	991	.486	35	2831		4044	
2. 10 mW/cm^2	1	1570	1547	.489	35	4420	1.1	4018	4007
		1605	1582	.495	36	4394		3995	
3. Control	2	894	871	.501	36	2419	0.3	8063	7722
		820	797	.495	36	2214		7380	
4. 10 mW/cm^2	2	1547	1524	.495	36	4233	0.7	6047	6129
		1588	1565	.495	36	4347		6210	
5. Control	3	1269	1246	.498	36	3461	0.4	8653	8816
		1280	1257	.489	35	3591		8978	
6. 10 mW/cm^2	3	1781	1758	.506	36	4883	0.7	6976	6986
		1786	1763	.498	36	4897		6996	

TABLE 12. DNA REPAIR STUDY: 1.2-GHz PULSE-WAVE RADIATION--[illegible]°C

	Incubation time (hr)	cpm .1 ml	-Bkg (27 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position	3	127	100	.535	38	263	0.7	376	380
		129	102	.534	38	268		383	
2. Exposure Position	3	135	10[illegible]	.570	40	270	0.9	300	305
		138	111	.557	40	278		309	
C. Assay for the induction of repair synthesis by 1.2-GHz pulse-wave radiation in non-UV-irradiated cells									
1. Control	3	147	120	.462	40	300	0.7	429	420
		145	118	.493	41	288		411	
2. RFR (10 mW/cm^2)	3	169	142	.458	39	364	0.9	404	398
		168	141	.461	40	353		392	

TABLE 12 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (2? cpm)	B/A Ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	D. Effect of 1.2-GHz pulse-wave radiation at 1 mW/cm^2 on UV-induced DNA repair								
1. Control	1	991	964	.416	37	2605	1.8	1447	1463
		985	958	.396	36	2661		1478	
2. 1 mW/cm^2	1	1846	1819	.426	37	4916	2.7	1821	1809
		1822	1795	.421	37	4851		1797	
3. Control	3	1718	1691	.421	37	4570	1.9	2405	2404
		1762	1735	.434	38	4566		2403	
4. 1 mW/cm^2	3	1066	1039	.420	37	2808	1.2	2340	2278
		1011	984	.417	37	2659		2216	
5. Control	3	835	808	.404	36	2244	1.0	2244	2097
		709	682	.387	35	1949		1949	
6. 1 mW/cm^2	3	1455	1428	.377	35	4080	1.6	2550	2555
		1460	1433	.376	35	4094		2559	

	Incubation time (hr)	cpm .1 ml	-Bkg (2' cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	E. Effect of 1.2-GHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair								
1. Control	1	615 638	588 611	.530 .556	38 40	1547 1528	0.7 [a]	2210 2183	2197 [b]
2. 10 mW/cm^2	1	1224 1164	1197 1137	.538 .535	39 38	3069 2992	1.3	2361 2302	2332
3. Control	2	1052 1066	1025 1039	.549 .543	39 39	2628 2664	0.7	3754 3806	3780
4. 10 mW/cm^2	2	1108 1082	1081 1055	.556 .548	40 39	2703 2705	0.7	3861 3864	3863
5. Control	3	1238 1194	1211 1167	.536 .540	38 39	3187 2992	0.7	4553 4274	4414
6. 19 mW/cm^2	3	1390 1367	1363 1340	.535 .521	38 38	3587 3526	0.9	3986 3918	3952

[a] Volume of [illegible] one of the Hinegardner replicates (0.7 and 1.3 µg/0.1 ml).
[b] The average of 2.1 µg 0.1 ml gives a final value of 2197 dpm/µg.

TABLE 11. DNA REPAIR STUDY: 1.2-GHz PULSE-WAVE RADIATION--33°C

	Incubation Time (hr)	cpm .1 ml	-Bkg (24 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
A. UV induced repair replication in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control	1	2759	2735	.424	36	7597	1.4	5426	5439
Position		2848	2824	.432	37	7632		4351	
2. Exposure	1	2802	2778	.429	37	7508	1.4	5363	5426
Position		2867	2843	.440	37	7684		5489	
3. Control	3	3697	3673	.426	37	9927	1.0	9927	9929
Position		3698	3674	.432	37	9930		9930	
4. Exposure	3	4439	4415	.424	36	12,264	1.4	8760	8593
Position		4389	4365	.431	37	11,797		8426	
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control	3	494	470	.497	37	1270	1.1	1155	1169
Position		505	481	.502	37	1300		1182	
2. Exposure	3	796	772	.483	36	2144	1.2	1787	1787
Position		796	772	.488	36	2144		1787	

(Cont'd. on next page)

TABLE 19 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (24 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
C. Assay for the induction of repair synthesis by 1.2-GHz pulse-wave radiation in non-UV-irradiated cells [a] (9 mW/cm^2)									
1. Control	3	681	657	.496	37	1776	0.4	4440	4430
		678	654	.505	37	1768		4420	
2. RFR (9 mW/cm^2)	3	928	904	.501	37	2443	0.7	3490	3612
		965	941	.487	36	2614		3734	
D. Effect of 1.2-GHz pulse-wave radiation at 1 mW/cm^2 on UV-induced DNA repair									
1. Control	1	1440	1416	.433	37	3827	0.4	9568	9429
		1436	1412	.447	38	3716		9290	
2. 1 mW/cm^2	1	1312	1288	.432	37	3481	0.3	11,603	11,473
		1283	1259	.436	37	3403		11,343	
3. Control	2	845	821	.444	37	2219	0.2	11,095	11,305
		876	852	.444	37	2303		11,515	
4. 1 mW/cm^2	2	2638	2614	.437	37	7065	0.5	14,130	14,184
		2658	2634	.434	37	7119		14,238	
5. Control	3	1136	1112	.433	37	3005	0.2	15,025	15,033
		1137	1113	.441	37	3008		15,040	
6. 1 mW/cm^2	3	2048	2024	.439	37	5470	0.3	18,233	18,000
		1996	1972	.435	37	5330		17,767	

(Cont'd. on next page)

[a] *Both exposed dish and control dish were incubated for 70 min with the irradiation label present before the 3-hr RFR exposure started.*

TABLE 13 (Cont'd.)

	Incubation time (hr)	cpm .1 ml	-Bkg (24 pm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
E. Effect of 1.2-GHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair									
1. Control	1	1912	1888	.484	36	5244	1.1	4767	4723
		1825	1801	.471	35	5146		4678	
2. 10 mW/cm^2	1	2252	2228	.486	36	6189	1.2	5158	5122
		2221	2197	.486	36	6103		5086	
3. Control	2	3106	3082	.482	36	8561	1.3	6585	6727
		3149	3125	.477	35	8929		6868	
4. 10 mW/cm^2	2	3611	3587	.488	36	9964	1.3	7665	7719
		3661	3637	.489	36	10,103		7772	
5. Control	3	3203	3179	.453	34	9350	1.3	7192	7157
		3172	3148	.456	34	9259		7122	
6. 10 mW/cm^2	3	3566	3542	.476	35	10,120	1.2	8433	8521
		3639	3615	.473	35	10.329		8608	

TABLE [illegible]

	Incubation time (hr)	cpm .1 ml	-Bkg (23 cpm)	B/A ratio	%Eff	dpm 1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.									
1. Control Position	3	130	107	.600	42	255	1.25	204	210
		136	113	.600	42	269		215	
2. Exposure Position	3	132	109	.537	38	287	1.3	221	224
		138	115	.543	39	295		227	
C. Assay for the induction of repair synthesis by 350 MHz pulse-wave radiation in non-UV-irradiated cells									
1. Control	3	159	136	.553	39	349	1.4	249	259
		170	147	.544	39	377		269	
2. RFR (10 mW/cm^2)	3	175	152	.563	40	380	1.3	292	287
		169	146	.556	40	365		281	

	Incubation time (hr)	cpm .1 mT	-Bkg (23 cpm)	B/A ratio	%Eff	dpm .1 mT	µg DNA .1 mT	dpm µg DNA	Avg dpm µg DNA
D. Effect of 350-MHz pulse-wave radiation at 1 mW/cm^2 on UV-induced DNA repair									
1. Control	1	689	666	.519	37	1800	2.3	783	777
		679	656	.517	37	1773		771	
2. 1 mW/cm^2	1	765	742	.530	38	1953	2.3	849	830
		768	745	.539	40	1863		810	
3. Control	2	637	614	.525	38	1616	1.5	1077	1078
		638	615	.524	38	1618		1079	
4. 1 mW/cm^2	2	839	816	.513	37	2205	1.7	1297	1203
		720	697	.506	37	1884		1108	
5. Control	3	895	872	.506	37	2357	1.8	1309	1315
		879	856	.499	36	2378		1321	
6. 1 mW/cm^2	3	260	237	.501	36	658	0.5	1316	1319
		261	238	.494	36	661		1322	

TABLE 16. DNA REPAIR STUDY: 350-MHz PULSE-WAVE RADIATION--39°C

[9 and 10 mW/cm^2]

	Incubation time (hr)	cpm .1 ml	-Bkg (.2 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	A. UV-induced repair replication in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.								
1. Control	1	995	973	.396	34	2862	.52	5504	5660
Position		1020	998	.386	33	3024		5815	
2. Exposure	1	943	921	.383	33	2791	.50	5582	5606
Position		979	957	.397	34	2815		5630	
3. Control	3	990	968	.381	33	2933	.28	10,475	11,213
Position		1193	1171	.407	35	3346		11,950	
4. Exposure	3	2389	2367	.413	35	6763	.62	10,908	10,551
Position		2234	2212	.408	35	6320		10,194	
	B. Background level of radioactivity incorporated into DNA of cells without UV exposure in an anechoic chamber with the generator on, culture dishes in the exposure vs. control position. The cells were not exposed to radiofrequency radiation.								
1. Control	3	135	113	.474	39	290	.40	725	742
Position		140	118	.467	39	303		758	
2. Exposure	3	210	188	.459	38	495	.55	900	940
Position		227	205	.446	38	539		980	

	Incubation Time (hr)	cpm .1 ml	-Bkg (.2 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
C. Assay for the induction of repair synthesis by 350-MHz pulse-wave radiation in non-UV-irradiated cells (5 mW/cm^2)									
1. Control	3	114	92	.464	38	242	.30	807	835
		118	96	.432	37	259		863	
2. RFR (5 mW/cm^2)	3	184	162	.475	39	415	.55	755	765
		184	162	.448	38	426		775	
D. Effect of 350-MHz pulse-wave radiation at 5 mW/cm^2 on UV-induced DNA repair									
1. Control	1	871	849	.421	36	2358	.64	3684	3683
		870	849	.417	36	2356		3681	
2. 5 mW/cm^2	1	1509	1487	.438	37	4019	1.14	3525	3521
		1505	1483	.431	37	4008		3516	
3. Control	2	1072	1050	.424	36	2917	.60	4862	5026
		1174	1152	.439	37	3114		5190	
4. 5 mW/cm^2	2	1058	1036	.418	36	2878	.60	4797	4792
		1056	1034	.417	36	2872		4787	
5. Control	3	1583	1561	.425	36	4336	.70	6194	6163
		1610	1588	.427	37	4292		6131	
6. 5 mW/cm^2	3	2274	2252	.410	36	6256	.95	6585	6293
		2074	2052	.417	36	5700		6000	

	Incubation Time (hr)	cpm / .1 ml	-Bkg (22 cpm)	B/A ratio	%Eff	dpm / .1 ml	µg DNA / .1 ml	dpm / µg DNA	Avg dpm / µg DNA
E. Effect of 350-MHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair									
1. *Control*	1	798	776	.382	33	2352	.92	2557	2580
		836	814	.395	34	2394		2602	
2. 10 mW/cm^2	1	1367	1345	.365	32	4203	1.84	2284	2399
		1548	1526	.387	33	4624		2513	
3. Control	2	1114	1092	.393	34	3212	.84	3824	4016
		1224	1202	.401	34	3535		4208	
4. 10 mW/cm^2	2	974	952	.401	34	2800	.68	4118	4256
		1008	986	.386	33	2988		4394	
5. Control	3	1701	1679	.410	35	4797	.90	5330	5206
		1577	1555	.389	34	4574		5082	
6. 10 mW/cm^2	3	1943	1921	.414	35	5489	.91	6032	5891
		1801	1779	.400	34	5232		5749	

					dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
...ity incorporated into DNA of cells without UV exposure ... generator 6, culture ...ishes in the exposure vs. ... were not exposed to radiofrequency radiation.								
		41	.420	41	180	0.6	167	165
		42	.429	42	98		163	
		39	.466	39	179	1.1	163	162
		39	.466	39	177		161	
...by the inhibition of repair synthesis by 850 MHz pulse-wave radiation in ... irradiated cells								
	92	71	.423	37	192	0.6	320	327
	99	78	.454	39	200		333	
	140	118	.417	35	340	0.7	486	476
	135	111	.342	35	326		466	

TABLE 3[illegible]

	Incubation Time (hr)	cpm .1 ml	-Bkg (21 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	D. Effect of 350-MHz pulse wave radiation at 1 mW/cm^2 on UV-induced DNA repair								
1. Control	1	948	927	.460	39	2377	1.6	1486	1469
		926	905	.464	39	2321		1451	
2. 1 mW/cm^2	1	809	788	.461	39	2021	1.3	1555	1544
		798	777	.460	39	1992		1532	
3. Control	2	979	958	.447	38	2521	.85	2966	2983
		990	969	.447	38	2550		3000	
4. 1 mW/cm^2	2	154	133	.467	39	341	0.15	2273	1917
		117	96	.491	41	234		1560	
5. Control	3	1215	1194	.452	38	3[illegible]	1.0	3142	3107
		1219	1198	.458	39	3072		3072	
6. 1 mW/cm^2	3	1886	1865	.449	38	4908	1.6	3068	3117
		1946	1925	.450	38	5066		3166	

	Incubation time (hr)	cpm .1 ml	-Bkg (21 cpm)	B/A ratio	%Eff	dpm .1 ml	µg DNA .1 ml	dpm µg DNA	Avg dpm µg DNA
	E. Effect of 850 MHz pulse-wave radiation at 10 mW/cm^2 on UV-induced DNA repair								
1. Control	1	290	269	.397	35	769	0.9	854	997
		370	349	.382	34	1026		1140	
2. 10 mW/cm^2	1	626	605	.400	35	1729	1.4	2535	1240
		648	627	.409	36	1742		1244	
3. Control	2	512	491	.322	30	1637	1.0	1637	1670
		549	528	.342	31	1703		1703	
4. 10 mW/cm^2	2	502	481	.395	35	1374	0.7	1963	2007
		509	488	.388	34	1435		2050	
5. Control	3	739	718	.367	33	2176	1.1	1978	2004
		758	737	.372	33	2233		2030	
6. 10 mW/cm^2	3	809	788	.383	34	2318	1.2	1932	1925
		780	759	.371	33	2300		1917	

TABLE 11. CLONAL SURVIVAL DATA, CHO CELLS, 850 MHz and 1.2 GHz, 37°C and 39°C

FREQUENCY	TEMP. (deg C)	SF
0.85	37	1.02
		0.99
		1.01
	39	1.00
		1.03
		0.98
1.2	37	0.99
		1.02
		1.01
	39	1.02
		1.01
		1.01

TABLE 12. SUMMARY OF GROWTH KINETICS, CHO CELLS, 850 MHz and 1.2 GHz, 37°C and 39°C

FREQUENCY	TEMP. (deg C)	LAMBDA CONTROL	LAMBDA EXPOSED
0.85	37	0.063	0.062
	39	0.064	0.063
1.2	37	0.063	0.064
	39	0.063	0.063

TABLE 10. SISTER CHROMATID EXCHANGE [illegible]

EXPT. #	FREQUENCY (GHz)	TEMP. (deg C)	SCE/CELL CONTROL (1 SD)	SCE/CELL EXPOSED (1 SD)
1	.85	37	10.74 (1.575)	9.88 (2.47)
			10.58 (.828)	10.3 (1.432)
			10.5 (.735)	10.58 (.731)
			10.46 (1.474)	10.62 (1.794)
2	.85	37	10.48 (1.488)	10.46 (.676)
			10.66 (.772)	10.58 (.758)
			10.6 (1.088)	10.72 (1.213)
			10.44 (.76)	10.44 (1.28)
3	.85	37	10.24 (1.021)	10.42 (.642)
			10.62 (.945)	10.02 (1.27)
			10.94 (2.316)	10.38 (.753)
			10.42 (.758)	10.38 (.878)
4	.85	39	10.34 (1.437)	10.44 (2.349)
			10.44 (.76)	10.54 (1.446)
			10.46 (1.501)	10.46 (1.129)
			10.54 (.734)	11.1 (1.607)
5	.85	39	10.54 (1.164)	10.38 (.845)
			10.48 (.809)	10.36 (1.711)
			10.52 (1.329)	10.5 (1.298)
			10.54 (.788)	10.46 (.894)
6	.85	39	10.44 (1.716)	10.54 (1.446)
			10.54 (.762)	10.58 (1.357)
			10.46 (2.111)	10.24 (1.437)
			10.6 (.571)	10.74 (.965)

TABLE 20. SISTER CHROMATID EXCHANGE FREQUENCY, CHO CELLS, 1.2 GHz, 37°C and 39°C

EXPT. #	FREQUENCY (GHz)	TEMP. (deg C)	SCE/CELL (1 SD) CONTROL	SCE/CELL (1 SD) EXPOSED
1	1.2	37	10.64 (1.102)	10.56 (.893)
			10.84 (1.765)	10.76 (1.744)
			10.4 (.881)	10.62 (1.141)
			10.5 (.707)	10.38 (1.978)
			10.44 (.861)	10.18 (.962)
			10.58 (1.214)	10.62 (1.413)
2	1.2	37	10.64 (.875)	10.08 (1.259)
			10.46 (.613)	10.66 (1.768)
			10.48 (.809)	10.44 (1.327)
			10.4 (.857)	10.58 (.673)
			10.56 (1.286)	10.5 (1.129)
			100.72 (.73)	10.42 (1.052)
3	1.2	37	10.66 (1.062)	10.3 (1.074)
			10.22 (1.788)	10.32 (.899)
			10.82 (1.385)	10.84 (1.808)
			10.38 (.897)	10.68 (1.203)
			10.54 (.706)	10.5 (.544)
			10.56 (.541)	11.04 (1.734)
4	1.2	37	10.54 (.894)	10.54 (1.232)
			10.36 (.898)	10.68 (.784)
			10.74 (1.259)	10.6 (.321)
			10.34 (.557)	10.82 (2.174)
			10.56 (.883)	10.44 (.704)
			10.34 (1.042)	10.74 (2.078)

(Cont'd. on next page)

TABLE 20 (Cont'd.)

EXPT. #	FREQUENCY (GHz)	TEMP. (deg C)	SCE/CELL CONTROL (1 SD)	SCE/CELL EXPOSED (1 SD)
5	1.2	39	10.92 (1.482)	10.22 (1.055)
			10.72 (1.691)	10.64 (.875)
			10.42 (1.052)	11.08 (2.239)
			10.44 (.541)	10.32 (1.382)
			10.92 (1.322)	10.4 (1.069)
			10.38 (1.086)	11.06 (2.411)
6	1.2	39	10.48 (2.206)	10.38 (2.048)
			10.28 (.858)	10.5 (.735)
			10.12 (1.674)	10.58 (1.739)
			10.4 (.99)	10.74 (.828)
			10.64 (.631)	10.5 (1.741)
			10.44 (1.053)	10.4 (.804)
7	1.2	39	10.7 (1.542)	10.48 (.831)
			10.48 (.677)	10.7 (1.819)
			10.5 (.614)	10.5 (.614)
			10.42 (1.162)	10.5 (.678)
			10.7 (1.199)	10.62 (1.413)
			10.28 (.807)	10.54 (.762)
8	1.2	39	10.74 (1.175)	10.44 (1.358)
			10.52 (1.432)	10.28 (1.98)
			10.38 (.067)	10.22 (2.141)
			10.22 (1.112)	10.58 (.785)
			10.32 (.587)	10.54 (.882)
			10.76 (1.384)	10.3 (.763)

DATE OF EXPOSURE	12/17/80	12/16/80	1/22/81	1/20/81	2/26/81	2/24/81	3/26/81	3/24/81
FREQUENCY	1.2 GHz	1.2 GHz	1.2 GHz	1.2 GHz	350 MHz	350 MHz	350 MHz	350 MHz
MODE	CW	CW	PW	PW	CW	CW	PW	PW
AVERAGE POWER DENSITY (mW/cm^2)	1	10	1	10	1	10	1*	10**
CHAMBER	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1
GENERATOR	Cober 1831	Cober 1831	Cober 1831	Cober 1831	MCL15022	MCL 15022	MCL 15022	MCL 15022
AMPLIFIER (if used)	----	----	----	----	----	----	MCL 10110	MCL 10110
TRANSITION DIMENSIONS (cm)	+ horn 34 x 46	+ horn 34 x 46	8.25x16.5	8.25x16.5	TEM Narda 8801	TEM Narda 8801	TEM Narda 8801	TEM Narda 8801
DISTANCE FROM TRANSITION (m)	1.0 (near field)	1.0 (near field)	1.5	1.5	TEM Narda 8801	TEM Narda 8801	TEM Narda 8801	TEM Narda 8801
DISTANCE FROM FLOOR (m)	0.85	0.85	0.85	0.85	TEM Narda 8801	TEM Narda 8801	TEM Narda 8801	TEM Narda 8801
TRANSMITTER OUTPUT POWER (W) (Average/Peak)	Not Recorded	Not Recorded	Not Recorded	Not Recorded	1.5	15	1.5/30	15/300
IF PULSED MODE:	--	----						
PULSES PER SECOND	--		5000	5000			5000	5000
PULSE WIDTH (μ sec)	--		10	10			10	10
PEAK POWER DENSITY (mW/cm^2) (AVERAGE D.F.)	--		20	200			20	200
DUTY FACTOR (PPS X Pulse width)	----		.05 Redone because of False parameters	.05			.05 Because of settings, could possibly have been Avg. Power Den. of *0.5 **5.0	.05

(Cont'd. on next page)

DF = duty factor
PPS = pulses per second

DATE OF EXPOSURE	8/13/81	8/11/81	9/11/81	9/9/81	11/19/81	11/17/81	1/21/82	1/19/82
FREQUENCY	850 MHZ	850 MHz	850 MHz	850 MHz	1.2 GHz	1.2 GHz	850 MHz	850 MHz
MODE	CW	CW	PW	PW	PW	PW	CW	CW
AVERAGE POWER DENSITY (mW/cm^2)	1	10	1	10	1	10	1	10
CHAMBER	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1	No. 1
GENERATOR	MCL 15022	MCL 15022	MCL 15022	MCL 15022	Cober 1831	Cober 1831	MCL 15022	MCl 15022
AMPLIFIER (if used)	MCL 10110	MCL 10110	MCL 10110	MCL 10110	----	----	MCL10110	MCL10110
TRANSITION DIMENSIONS (cm)	17x33.5	17x33.5	17x33.5	17x33.5	8.25x16.5	8.25x16.5	17x33.5	17x33.5
DISTANCE FROM TRANSITION (m)	1.38	1.38	1.38	1.38	1.5	1.5	1.38	1.38
DISTANCE FROM FLOOR (m)	0.85	0.85	0.85	0.85	0.75	0.75	0.85	0.85
TRANSMITTER OUTPUT POWER (W) (Average/Peak)	35	350	26/520	250/500	30/125	380/1583	28	280
IF PULSED MODE:								
PULSES PER SECOND	--		5000	5000	80,000	80,000		
PULSE WIDTH (μ sec)	--		10	100	3	3		
PEAK POWER DENSITY (mW/cm^2) (AVERAGE D.F.)	--		20	20	4.2	41.7		
DUTY FACTOR (PPS .. Pulse width)			.05	.5	.24	.24		
	Redone because of low ^3H uptake							

(Cont'd. on next page)

TABLE 3 (Cont'd.)

DATE OF EXPOSURE	3/2/82	3/4/82	4/27/82	4/22/82	4/30/82	6/15/82	6/11/82	7/29/82
FREQUENCY	850 MHZ	850 MHz	1.2 GHz	1.2 GHz	350 MHz	850 MHz	850 MHz	1.2 GHz
MODE	PW 39°	PW 39°	PW	PW	PW	PW 39°	PW 39°	PW 39°
AVERAGE POWER DENSITY (mW/cm^2)	1	10	1	10	1	1	10	1
CHAMBER	No. 1	No. 1	No. 2	No. 2	No. 1	No. 2	No. 2	No. 2
GENERATOR	MCL 15022	MCL 15022	Cober 1831	Cober 1831	MCL 15022	MCL 15022	MCL 15022	Cober 1831
AMPLIFIER (if used)	----	MCL 10110	----	----	MCL 10110	MCL 10110	MCL10110	---
TRANSITION DIMENSIONS (cm)	17x33.5	17x33.5	8.25x16.5	8.25x16.5	TEM Narda 8801	17x33.5.5	17x33.5	8.25x16.5
DISTANCE FROM TRANSITION (m)	1.38	1.38	1.5	1.5	TEM Narda 8801	1.38	1.38	1.38
DISTANCE FROM FLOOR (m)	0.85	0.85	1.08	1.08	TEM Narda 8801	1.08	1.08	1.08
TRANSMITTER OUTPUT POWER (W) (Average/Peak)	23/46	300/600	33/138	280/1167	4.6/92	22/44	147/294	44/183
IF PULSED MODE:								
PULSES PER SECOND	5000	5000	80,000	80,000	5000	5000	5000	80,000
PULSE WIDTH (μ sec)	100	100	3	3 0	10	100	100	3
PEAK POWER DENSITY (mW/cm^2) (AVERAGE D.F.)	2	20	4.2	41.7	20	2	20	4.2
DUTY FACTOR (PPS X Pulse width)	.5	.5	0.24	0.24	0.05	.5	.5	0.24

(Cont'd. on next page)

TABLE 21 (Cont'd.)

DATE OF EXPOSURE	7/27/82	9/10/82	9/8/82
FREQUENCY	1.2 GHz	350 MHz	350 MHz
MODE	PW 39°	PW 39°	PW 39°
AVERAGE POWER DENSITY (mW/cm^2)	10	10	5
CHAMBER	No. 2	No. 1	No. 1
GENERATOR	Cober 1326	MCL 15022	MCL 15022
AMPLIFIER (if used)	----	MCL 10110	MCL 10110
TRANSITION DIMENSIONS (cm)	8.25x16.5	TEM Narda 8801	TEM Narda 8801
DISTANCE FROM TRANSITION (m)	1.38	TEM Narda 8801	TEM Narda 8801
DISTANCE FROM FLOOR (m)	1.08	TEM Narda 8801	TEM Narda 8801
TRANSMITTER OUTPUT POWER (W) (Average/Peak)	413/1721	32/640	16/320
IF PULSED MODE:			
PULSES PER SECOND	80,000	5000	5000
PULSE WIDTH (μ sec)	3	10	10
PEAK POWER DENSITY (mW/cm^2) (AVERAGE D.F.)	42	20	200
DUTY FACTOR (PPS X Pulse width)	0.24	.05	.05

APPENDIX A: CYTOGENETICS AND GROWTH KINETICS DATA, 850 MHz

APPENDIX B: CYTOGENETICS AND GROWTH KINETICS DATA, 1.2 GHz

(For: USAFSAM-TR-84-24: GENETIC EFFECTS OF MICROWAVE EXPOSURE ON MAMMALIAN CELLS IN VITRO: VOLUME II, by Martin L. Meltz, Ph.D.; Clifton R. Harris, Ph.D.; and Kathleen A. Walker, B.S.)

RE: How to Order Appendix A (USAFSAM-TR-84-24-APP-A)
How to Order Appendix B (USAFSAM-TR-84-24-APP-B)

In order for comprehensive information on this research to be accessible, microfiche have been made of these Appendixes. The microfiche are available through:

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